NIELSEN ENGINEERING AND RESEARCH INC MOUNTAIN VIEW CA F/G 20/4
PREDICTION OF SUPERSONIC STORE SEPARATION CHARACTERISTICS INCLU-ETC(U)
NOV 80 J MULLEN, F K GOODWIN, M F DILLENIUS F33615-76-C-3077
NEAR-TR-210-VOL-3 NL AD-A099 331 UNCLASSIFIED 1003 8099 531

AFWAL-TR-80-3032 VOLUME III

PREDICTION OF SUPERSONIC STORE SEPARATION CHARACTERISTICS INCLUDING FUSELAGE AND STORES OF NONCIRCULAR CROSS SECTION.

VOLUME III - APPENDICES A AND B, DETAILS OF PROGRAM I



Joseph Mullen, Jr.
Frederick K. Goodwin
Marnix F. E. Dillenius
Nielsen Engineering & Research, Inc.
Mountain View, California 94043

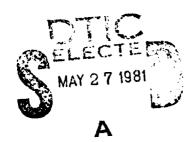
November 1980

TECHNICAL REPORT AFWAL-TR-80-3032, VOLUME III FINAL REPORT FOR PERIOD JUNE 1975 - FEBRUARY 1980

Approved for Public Release, Distribution Unlimited

THE FILE COPY

FLIGHT DYNAMICS LABORATORY AIR FORCE WRIGHT AERONAUTICAL LABORATORIES AIR FORCE SYSTEMS COMMAND WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433



13mil

#### NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

Calvin T. Dyes

CALVIN L. DYER Project Engineer POWALD O ANDERSON Chas

RONALD O. ANDERSON, Chief Control Dynamics Branch

FOR THE COMMANDER

ROBERT C. ETTINGER, Col, USAF, Chief

Flight Control Division

"If your address has changed, if you wish to be remived from our mailing list, or if the addressee is no longer employed by your organization please notify <a href="AFWAL/FIGC">AFWAL/FIGC</a>, W-PAFB, OH 45433 to help us maintain a current mailing list."

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on the specific document. AIR FORCE/56780/7 April 1981 - 170

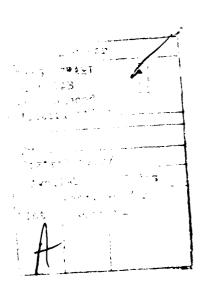
# (19) TR-80-3032-VOL-3

	N PAGE	BEFORE COMPLETING FORM
REPORT NUMBER		3. RECIPIENT'S CATALOG NUMBER
AFWAL TR-80-3032, Vol. III	AD- A099	332
PREDICTION OF SUP	ERSONIC STORE	YPE OF REPORT A PERIOD COVERED
SEPARATION CHARACTERISTICS INCLUD		G)Final Report - June 1975 — February 1980
STORES OF NONCIRCULAR CROSS SECTI Appendices A and B, Details of Pr		PERFORMING ORG. REPORT NUMBER
	1697330	4 NEAR-TR-210-10-1
Joseph Mullen, Jr.		Common on chart homben(e)
Frederick K./Goodwin	(13	F33615-76-C-3977
Marnix F. E./Dillenius		
PERFORMING ORGANIZATION NAME AND ADDRES		10. PROGRAM ELEMENT, PROJECT, TASK
Nielsen Engineering & Research, I	inc.	Project 2403
510 Clyde Avenue Mountain View, CA 94043	1 1 11 16	766R 240305
CONTROLLING OFFICE NAME AND ADDRESS		Work Unit 240309
Flight Dynamics Laboratory		November 1980
Air Force Wright Aeronautical Lab Air Force Systems Command	oracories //	19: HUMBER OF PAGES
Wright-Patterson Air Force Base,  Monitoring Agency Name & Address(it differ		210 15. SECURITY CLASS. (of this report)
	some symile of the e	32.02.03
		Unclassified
		15. DECLASSIFICATION DOWNGRADING SCHEDULE
6 DISTRIBUTION STATEMENT (of this Report)		<u> </u>
		·
		•
8 SUPFLEMENTARY TES		•
8 SUPPLEMENTARY TES  9 KEY WORDS (Continue on reverse side if necessary	and identify by block number.	
9 KEY WORDS (Continue on reverse aide if necessary  Aerodynamic Loads	Flow Fields	
9 KEY WORDS (Continue on reverse aide if necessary  Aerodynamic Loads  Aerodynamic Interference	Flow Fields Store Separation	
Aerodynamic Loads Aerodynamic Interference	Flow Fields	
Aerodynamic Loads Aerodynamic Interference External Stores	Flow Fields Store Separation Supersonic Flow	
Aerodynamic Loads Aerodynamic Interference External Stores  Asstract (Continue on reverse side if necessary a local culates the six-degree-of-free separated from fighter-bomber type	Flow Fields Store Separation Supersonic Flow  and identity by block numbers resented for using dom trajectories of e aircraft flying	a computer program which of external stores which are at supersonic speeds.
Aerodynamic Loads Aerodynamic Interference External Stores  Detailed instructions are preparated from fighter-bomber type Multiple circular or elliptic storaircraft configurations may consist	Flow Fields Store Separation Supersonic Flow  and identity by block numbers resented for using dom trajectories of e aircraft flying re configurations st of a circular of ession inlets, and	a computer program which of external stores which are at supersonic speeds. may be handled. Parent or arbitrary cross section la wing, pylon, and rack.
Aerodynamic Loads Aerodynamic Interference External Stores  Asstract (Continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a constitution of the continue on reverse side if necessary a continue on reverse side if necessary and reverse side i	Flow Fields Store Separation Supersonic Flow  and identity by block numbers resented for using dom trajectories of e aircraft flying re configurations st of a circular of ession inlets, and -flow theory to mo	a computer program which of external stores which are at supersonic speeds. may be handled. Parent or arbitrary cross section I a wing, pylon, and rack. odel the wing and pylon
Aerodynamic Loads Aerodynamic Interference External Stores  Detailed instructions are processed from fighter-bomber type Multiple circular or elliptic storaircraft configurations may consist fuselage with ramp external compressions.	Flow Fields Store Separation Supersonic Flow  and identity by block numbers resented for using dom trajectories of e aircraft flying re configurations st of a circular of ession inlets, and -flow theory to mo	a computer program which of external stores which are at supersonic speeds. may be handled. Parent or arbitrary cross section I a wing, pylon, and rack. odel the wing and pylon
Aerodynamic Loads Aerodynamic Interference External Stores  Asstract Continue on reverse side if necessary a constitution of the continue on reverse side if necessary and in the continue of the continue	Flow Fields Store Separation Supersonic Flow  and identify hy block numbers resented for using dom trajectories of e aircraft flying re configurations st of a circular of ession inlets, and -flow theory to mo ensional line sour	a computer program which of external stores which are at supersonic speeds. may be handled. Parent or arbitrary cross section I a wing, pylon, and rack. odel the wing and pylon

#### 20. (Continued)

to model circular fuselages and stores. The noncircular fuselage and elliptic store surfaces are modeled with constant source panels. Nonlinear corrections are made to the wing, fuselage, rack, store and fuselage inlet models to simulate shocks. The program also calculates the trajectory of the store as it separates from the aircraft. This report describes the program, presents instructions for preparing input for the program, describes the output from the program, and presents a sample case. The program represents an extension of an earlier program restricted to circular bodies at supersonic speeds, written by the present authors and described in AFFDL-TR-76-41.

This volume presents the detailed descriptions of the calculations performed in each of the subroutines in Program I. Also included are the descriptions of each of the variables passed between routines.



#### **FOREWORD**

This report entitled "Prediction of Supersonic Store Separation Characteristics Including Fuselage and Stores of Noncircular Cross Section," describes a combined theoretical-experimental program directed toward developing a computer program for predicting the trajectory of an external store separated from an aircraft flying at supersonic speed. It represents an extension of previous work covered in AFFDL-TR-76-41 to include more realistic modeling of fuselage shapes including noncircular cross sections and ramp type engine air inlets, and to include modeling store shapes with elliptic cross section with multiple sets of arbitrarily oriented fins. Volume I, "Theoretical Methods and Comparisons with Experiment", describes the theoretical approach and presents extensive comparisons with experimental data. Volume II, "Users Manual for the Computer Program", presents detailed instructions on the use of the computer program with emphasis on preparation of input data and interpretation of output. This volume, Volume III, "Appendices A and B, Details of Program I", provides additional descriptions of the individual subroutines and program variables passed between modules in the first of two programs. Volume IV, "Appendices C and D, Details of Program II", provides additional descriptions of the individual subroutines and program variables passed between modules in the second program.

This work was carried out by Nielsen Engineering & Research, Inc. (NEAR), 510 Clyde Avenue, Mountain View, California 94043, under Contract No. F33615-76-C-3077. The contract was initiated under Project 2403, Task 240305, of the Air Force Flight Dynamics Laboratory. The Air Force Project Engineer on the contract was Calvin L. Dyer, AFWAL/FIGC. The report number assigned by Nielsen Engineering & Research, Inc. is NEAR TR 210.

## TABLE OF CONTENTS

Section		Page No.
APPENDIX	A - DETAILS OF PROGRAM I SUBROUTINES	2
A-1	Introduction	2
A-2	Program LDCALC	7
A-3	Subroutine ASECTN	. 8
A-4	Subroutine BDYGEN	8
A-5	Subroutine BLYOUT	12
A-6	Subroutine BLYOT2	14
A-7	Subroutine BODPAN	14
A-8	Subroutine BODPN2	15
A-9	Subroutine BODVEL	17
A-10	Subroutine BSHOCK	19
A-11	Subroutine CONFIG	. 21
A-12	Suproutine DOUBLT	22
A-13	Subroutine DPCOEF	23
A-14	Subroutine DPRHS	. 25
A-15	Subroutine FLDVEL	26
A-16	Subroutine FLDVL2	27
A-17	Subroutine FRSTRT	29
A-18	Subroutine FUSEIO	31
A-19	Subroutine GEOM	32
A-20	Subroutine INLSHK	33
A-21	Function INLTST	36
A-22	Subroutine INLXYZ	36
A-23	Subroutine INVER1	37
A-24	Subroutine IOREAD	38
A-25	Subroutine IOWRIT	39
A-26	Subroutine NETCLC	39
A-27	Subroutine NEWRAD	41
A-28	Subroutine NEWRD2	41
	Subroutine NULYT	43
	Cubrouting DANE:	46

## TABLE OF CONTENTS (Continued)

Section			Page No.
A-31	Subroutine	PANVEL	4.7
A-32	Subroutine	PAS001	48
A-33	Subroutine	PAS002	49
A-34	Subroutine	PLYOUT	50
A-35	Subroutine	P THIN	51
<b>A-36</b>	Subroutine	RACKIO	52
A-37	Subroutine	SHAPE	52
A-38	Subroutine	SHKSHP	53
A-39	Subroutine	SMARCH	55
A-40	Subroutine	SOLVE	56
A-41	Subroutine	SORPAN	57
A-42	Subroutine	SOURCE	57
A-43	Subroutine	STORIO	58
A-44	Subroutine	SWNGIN	60
A-45	Subroutine	THKLYT	60
A-46	Subroutine	THKOUT	62
A-47	Subroutine	VELBD1	62
A-48	Subroutine	VELCAL	65
A-49	Subroutine	VELCMP	66
A-50	Subroutine	VELO1	67
<b>A-51</b>	Subroutine	VELOT1	69
A-52	Subroutine	VELPP1	71
A-53	Subroutine	VELPT1	73
A-54	Subroutine	VELWP1	74
A-55	Subroutine	VELWT1	76
A-56	Subroutine	WDYBDY	77
A-57	Subroutine	WITHIN	78
A-58	Subroutine	WLYOUT	78
<b>A-</b> 59	Subroutine	WRFILE	79
A-60	Subroutine	YZBIP	80
<b>Δ-6</b> 1	Subroutine	VZRTD2	81

## TABLE OF CONTENTS (Concluded)

Section	Page No.
APPENDIX B - COMMON BLOCK DESCRIPTIONS - PROGRAM I	171
B-1 Introduction	171
B-2 Description of Variables in Labeled Commons	171
B-3 Blank Common	193
REFERENCES	202

## LIST OF ILLUSTRATIONS

Figure		Page No.
A-1	Listing of Program I	83
A-2	General Flow Chart of Subroutine Calls in Program	139
A-3	Flow Chart of Subroutine BDYGEN	142
A-4	Flow Chart of Subroutine BLYOUT	144
<b>A-</b> 5	Flow Chart of Subroutine DPCOEF	146
<b>A-</b> 6	Flow Chart of Subroutine DPRHS	148
A-7	Flow Chart of Subroutine FUSEIO	151
A-8	Flow Chart of Subroutine NULYT	152
<b>A-</b> 9	Flow Chart of Subroutine PLYOUT	154
A-10	Flow Chart of Subroutine RACKIO	156
A-11	Flow Chart of Subroutine SHAPE	157
A-12	Flow Chart of Subroutine STORIO	158
A-13	Flow Chart of Subroutine THKLYT	160
A-14	Flow Chart of Subroutine VELBD1	162
A-15	Flow Chart of Subroutine VELO1	164
A-16	Flow Chart of Subroutine VELPP1	166
A-17	Flow Chart of Subroutine VELWP1	168
A-18	Flow Chart of Subroutine WLYOUT	170
B-1	Common Statements and the Routines in Which They Appear	201

### PREDICTION OF SUPERSONIC STORE SEPARATION CHARACTERISTICS INCLUDING FUSELAGE AND STORES OF NONCIRCULAR CROSS SECTION

Volume III - Appendices A and B, Details of Program I

#### SUMMARY

The purpose of this volume is to provide the additional details of the parts of the first program that would be useful to the programmer or engineer interested in understanding the calculations and computer code herein. The information included here as Appendices A and B describes the function and operations performed by each routine, a description of data transferred between subroutines and a listing of Program I itself.

Appendix A provides a detailed description of the operations and flow of calculations of each of the individual routines in Program I. Included are a description of the flow of the calculations, including flow charts of some routines, a description of any program arguments, and a program listing.

Appendix B provides a description of all variables passed between routines in common blocks. A listing of each common block with a description of each variable, array, or index in the common is provided. A special section is provided for the multiple uses of blank common as well as a cross reference chart of routine versus common block usage.

## APPENDIX A DETAILS OF PROGRAM I SUBROUTINES

#### A-1 Introduction

The purpose of this appendix is to provide more detailed information on the calculations performed in the first program which was described in Section 3 of Volume II. A listing of Program I is presented in Figure A-1 and a general flow chart in Figure A-2. This appendix will present the details of the flow of the calculations for each routine, a description of the variables in the argument list, individual detailed flow charts, and a summary of the functions of each routine. The program consists of a main program and 59 subroutines. The main program will be described and then the subroutines will be described in alphabetical order. The subroutines and their functions are listed in Table A-1. Flow charts of some of the individual routines are shown in Figures A-3 through A-18. Refer to Volume II of this report for the list of symbols used in this text.

TABLE A-1. SUBROUTINES USED IN PROGRAM I

Subroutine			
Name	Function		
LDCALC	main program to organize galgulation flow		
LDCALC	main program to organize calculation flow		
ASECTN	calculates cross sectional area of an arbitrarily		
	paneled body		
BDYGEN	calculates line sources and doublets to give a		
	required body shape and angle of attack		
BLYOUT	lays out fuselage constant u-velocity panels for		
	circular body		
BLYOT2	lays out noncircular fuselage constant u-velocity		
	panels		

BODPAN	organizes the calculation of the revised axial
	spacing for the noncircular fuselage source panels
BODPN 2	performs the revision of the axial spacing on the
	noncircular bodies and computes the body panel
	geometry
BODVEL	organizes the looping through source panels to
	compute panel influence coefficients
BSHOC K	computes the nonlinear shock wave shape emanating
	from the nose of a noncircular body
CONFIG	reads and prints the input geometrical description
	of the external shape of noncircular fuselage or
	elliptic stores
DOUBLT	calculates the strength of a linear line doublet
DPC OEF	calculates coefficient matrix of the set of equations
	to be solved for the wing-pylon-fuselage constant
	u-velocity panel strengths
DPRHS	calculates right-hand side of the set of equations
	to be solved for the wing-pylon-fuselage constant
	u-velocity panel strengths
FLDVEL	organizes the calculation of the u,v,w velocity
	components at the field points XFP,YFP,ZFP
FLDVL2	computes the three components of velocity induced
	at field points by the source panels of a given
	body ring
FRSTRT	saves or restores required program information
	for source panel model to restart configuration
	analysis
FUSEIO	reads and prints fuselage data and calls BDYGEN
	to calculate line source and doublet distributions
	and SHKSHP to compute nonlinear shock for circular
	bodies
GEOM	organizes the reading and printing of the noncircular
	body input and the calculation of the source panel
	geometry arrays

INLSHK	computes the nonlinear shock shape emanating
	from a ramp type inlet
INLTST	determines whether a source panel is an inlet
	panel
INLXYZ	scans the x,y,z coordinates of the inlet panel
	corners to determine inlet geometric parameters
INVER1	solves a system of simultaneous linear algebraic
	equations
IOREAD	performs an unformatted read from external
	file, IO
IOWRIT	performs an unformatted write onto the external
	file, IO
NETC LC	calculates the net corner strengths for a given
	set of wing, pylon, or fuselage constant u-velocity
	panels
NEWRAD	organizes the revision of the noncircular body
	meridian line spacing for the source panels
NEWRD 2	computes the revised noncircular body meridional
	line spacing for a given body segment
NULYT	selects a subset of constant u-velocity and wing
	and pylon thickness panel layout data and calculates
	and saves the net strengths associated with each
	panel corner
PANEL	calculates the direction cosines of the normal
	vector, the centroid, area and inclination angles
	of an arbitrary quadrilateral panel
PANVEL	transforms field points into local panel
	coordinates and calls SORPAN for the calculation
	of the panel influence coefficient
PAS001	performs the L*U decomposition of a positive
	definite matrix
PAS002	solves the system of equations $[L*U]*X \approx B$
PLYOUT	reads and prints pylon data and lays out
	constant u-velocity panels on the pylon

A STATE OF

PYTHIN	reads pylon thickness data
RACKIO	reads and prints the rack data and calculates
	the rack source and doublet distributions
SHAPE	calculates the radius and surface slope at a
	point on a body from input polynomials
SHKSHP	calculates the nonlinear shape of the shock wave
	shape produced by an axisymmetric body at zero
	angle of attack
SMARCH	solves for the source panel strengths in
	supersonic flow using a ring by ring marching
	technique
SOLVE	computes the source panel boundary condition for
	a noncircular body in the presence of a free stream
	angle of attack and calls SMARCH to compute the
	panel strengths
SORPAN	computes the three velocity components induced at
	a specified control point by a constant source panel
	inclined to the free stream
SOURCE	calculates the strength of a linear line source
STORIO	reads and prints store data and computes circular
	body line source and doublet distributions and
	shock shapes or elliptic store source panel
	strengths and shock shape
SWNGIN	reads and prints wing constant u-velocity panel
	data and twist and camber data, if any
THKLYT	lays out wing and pylon thickness panels
THKOUT	prints wing and pylon thickness panel input data
VELBD1	calculates influence functions due to a fuselage
	constant u-velocity panel
VELCAL	calculates velocities at a field point due to
	fuselage or store line sources and doublets
VELCMP	organizes and calls for the calculation of the
	aerodynamic influence coefficient matrices for the
	body source panels

VELO1	calculates the influence of a semi-infinite
	triangle associated with a constant u-velocity
	panel
VELOT1	calculates the influence of a semi-infinite
	triangle associated with a thickness source panel
VELPP1	calculates influence functions due to a pylon
	constant u-velocity panel
VELPT1	calculates velocities at a field point due to
	pylon thickness source panels
VELWP1	calculates influence functions due to a wing
	constant u-velocity panel
VELWT1	calculates velocities at a field point due to
	wing thickness source panels
WDYBDY	reads and prints noncircular fuselage data and
	organizes the calls for the body source panel
	layout, source strengths and nonlinear shock
	shape
WITHIN	reads wing thickness data
WLYOUT	lays out constant u-velocity panels on wing
WRFILE	writes the dataset on TAPE12 which contains the
	information required to continue the supersonic
	store separation computations in Program II
YZBIP	organizes the scan of the source panel geometry to
	define the cross section of the noncircular
	fuselage interference shell
YZBIP2	interpolates in the panel geometry of a segment to
	define the y-z values of the noncircular interference
	shell

#### A-2 Program LDCALC

The flow chart which was presented in Figure 2 of Volume II details the basic flow of the calculations in program LDCALC and will not be expanded in this appendix. A written summary of the calculations to be made in the first program is presented. A listing of the program is presented in Figures A-1(a) and A-1(b) of this report.

LDCALC organizes the reading and printing of input and the calculation of the strengths of the singularities modeling the individual parent aircraft and store components. The constants, flow conditions, and component options are first defined. source strength solutions are then defined for the circular fuselage in FUSEIO or for the noncircular fuselage in WDYBDY. wing u-velocity panel data are read in SWNGIN and the panel layout is defined in WLYOUT. The wing thickness data are read in WITHIN. PLYOUT and PYTHIN perform similar functions for the pylon. thickness distribution is printed from THKOUT and the thickness panel layout for wing and pylon occurs in THKLYT. The u-velocity panel layout for the circular fuselage is generated in BLYOUT and in BLYOT2 for the noncircular fuselage. A source strength model may also be generated for the rack in RACKIO. The source strength determination for either circular or elliptic store bodies are then computed in STORIO. The right hand side and influence coefficients for the u-velocity panels are computed in DPRHS and DPCOEF, respectively. The panel solutions are solved for from the set of simultaneous equations in INVER1. A summary of the panel control points and solutions is printed. The modified layout based on strengths summed at panel corners is then generated in The necessary arrays and variables are lastly saved on TAPE12 in WRFILE for restarting the problem in the second program.

Subroutine references

BLYOUT, BLYOT2, DPCOEF, DPRHS, FUSEIO, NULYT, PLYOUT, PYTHIN, RACKIO, STORIO, SWNGIN, THKLYT, THKOUT, WDYBDY, WITHIN, WLYOUT, WRFILE.

#### A-3 Subroutine ASECTN

Subroutine ASECTN computes the cross sectional area of an arbitrarily paneled body. It is used to compute the area enclosed by arbitrary Y and Z values at each station in the external specification of the body shape. It is called from CONFIG. The equation used to define the area is

AREA = 
$$\sum_{i=2}^{NRAD} \frac{1}{2} (Y_i \cdot Z_{i-1} - Y_{i-1} \cdot Z_i)$$
 (A-1)

If the body is symmetric the sum is computed for the half body and doubled. A listing of the routine is presented in Figure A-1(b) of this report. A description of the parameters in the argument list follows:

Y,Z arrays of section corner points
NRAD number of points around section
AREA area of cross section

Called by

#### A-4 Subroutine BDYGEN

Subroutine BDYGEN calculates the line source and doublet strengths using control points on the surface of the fuselage and store. The method used is described in Appendix I of Reference 1. A listing of the subroutine is presented in Figure A-1(c) and a flow chart in Figure A-3 of this report. The

coordinate system associated with the subroutine is shown in the sketches of Appendix I of Reference 1.

At the beginning of the subroutine a test is performed to determine if, at the base of the body, the radial distance to the Mach cone emanating from the body nose is less than the maximum radius of the body. If so, an error message is printed out (see Section 3.5 of Volume II) and the program stops.

Next, as the flow chart indicates, N is set equal to NXBODY - 1 and the body axis is divided into N segments of equal length.

The x locations of the body definition points, XBODY(J), are determined at these equally spaced axis points and, inside a short DO loop, subroutine SHAPE is called to calculate the radius of the body, RBODY, and the surface slope, RPBODY, at each body definition point. Subroutine SHAPE requires that the shape definition quantities be made dimensionless by body length. Subroutine BDYGEN accounts for this before and after the calls to subroutine SHAPE. Next, the control points are located effectively midway between the body definition points. Subroutine SHAPE calculates the body radius, RF, and the surface slope, DRDX, at each control point. Finally, the axis points, TX, which are the origins of the conical line sources and doublets, are determined.

The next sections of the subroutine are devoted to revising the layout of the body definition points and control points and the origins of the line singularities if the first control point lies outside the Mach cone originating at the body nose. An iteration is performed to determine the intersection of the cone with the body surface. Once this point is found the body definition points are redistributed over the remainder of the body. The procedure described in the previous paragraph is used

to redefine the control points and the origins of the line singularities.

The remainder of the subroutine calculates the source and doublet strengths at the control points. Subroutine SOURCE is called and the source strength at the first control point is calculated using Equation (I-14) and at the remaining control points using Equation (I-17) of Reference 1. One should note that the Ith source strength, T(I), is the constant  $K_{I-1}$  in the algebraic notation of the equations. Similarly, using subroutine DOUBLT, the doublet strengths are calculated using Equation (I-27) for the first control point and Equation (I-28) of Reference 1 for the remaining control points. Here, the Ith doublet strength, TC(I), equals  $K_{d,I-1}$ .

After calculating the source and doublet strengths, the subroutine prints the body definition point data, the singularity origins, and the singularity strengths and sums the source and doublet strengths. A description of the parameters in the argument list follow:

NXBODY number of body defin	ition	points
-----------------------------	-------	--------

RADIUS	maximum	radine	οf	hody
RAULUS	111 A X 1 111 1 1 1 1 1 1 1 1 1 1 1 1 1	1 40 1 115	() L	()()() V

BODYL	length of actual	bodv

NSEG	number	οf	polynomials	used t	o spe	cify	body	shape
------	--------	----	-------------	--------	-------	------	------	-------

XEND	array containing x locations of end points of
	polynomial sections specifying body shape, made
	dimensionless by body length

SCOEF array containing coefficients of polynomials used to specify body shape

T array containing source strengths; T(J) is the quantity  $K_{J-1}$  calculated by Equations (I-14) and (I-17) of Reference 1

TC array containing doublet strengths; TC(J) is the quantity  $K_{d,J-1}$  calculated by Equations (I-27) and (I-28) of Reference 1

TX array containing x locations of origins of conical line sources and doublets; positive, measured from tip of nose

ALPHA angle measured between the body centerline and the free-stream direction

RPBODY(I) slope of body surface at Ith body definition point

LBODY BODYL\*XEND (NSEG)

SUMK sum of the source strengths

SUMKD sum of the doublet strengths

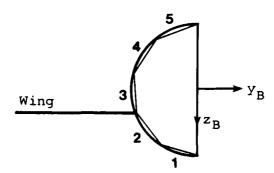
Subroutine references
DOUBLT, SHAPE, SOURCE

Called by FUSEIO, RACKIO, STORIO

#### A-5 Subroutine BLYOUT

Subroutine BLYOUT calculates quantities needed to define the constant u-velocity panels on the circular fuselage and to locate the panel control points. The corner and control point coordinates calculated for the body panels are stored in arrays in locations which follow the same quantities calculated for the wing and pylon constant u-velocity panels. All coordinates are in the wing coordinate system which is shown in Figure 6 of Volume II. A listing of the subroutine is presented in Figure A-1(d) and a flow chart in Figure A-4.

The fuselage interference panels are laid out on the left-half of the fuselage surface, as shown in Figure 3 of Volume II. The panel numbering convention employed in a typical ring containing five panels, three above the wing and two below, is shown in the following sketch.

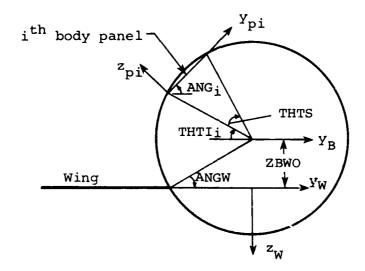


At the beginning of the subroutine, quantities DX, NBD, NBIP, and ANGW, associated with the geometry of the entire panel layout, are calculated. Next, the variable ANGW is tested to determine if the ving is tangent to the fuselage, either at the top or at the bottom. As the flow chart shows, this tangency condition determines the initialization procedure performed before the main loop calculations.

The main part of the subroutine is a double DO loop with the outer loop index running over the rows above or below the wing and the inner loop index over the NCWB panels in a lengthwise

row. If the wing is not tangent, this double loop is performed first for the panels below the wing, then repeated for the panels above the wing.

For a given lengthwise row the y,z coordinates of the panel corners and the control points are first obtained in the panel coordinate system. The following sketch shows the coordinate system and certain quantities associated with a panel located above the wing.



Within the inner DO loop the coordinates are transformed into the wing coordinate system and stored in appropriate array locations. Polar angle THTI and quantities SNT2 and CST2, necessary for panel-wing transformations, are saved in arrays for subsequent use by other routines. The corner and control point  $\mathbf{x}_{\mathbf{w}}$  coordinates are calculated and stored; no transformations are necessary for these quantities.

The convention employed in labeling the corner coordinates for the fuselage interference panels is that the right side of the panel is located in clockwise rotation from the left side, when looking forward.

Called by LDCALC

#### A-6 Subroutine BLYOT2

Subroutine BLYOT2 computes the u-velocity panel corner points, control points, and transformation angles for the noncircular fuselage body shape. The section geometry is obtained from YZBIP at the user specified body x-station in the arbitrary fuselage geometry description. The section generated is held constant in cross section in the axial direction. No logic has been provided to force panel edges at the wing-body interface to match. The initial paneling of the body by the user must be performed so as to guarantee the matching of the panel edges with the wing root chord. A listing of the routine is presented in Figure A-1(e) of this report.

BLYOT2 performs two loops when generating the tables of panel properties. The outer DO loop steps through the number of panels around the circumference to generate the local section properties as shown in Figure 18 of Volume II. The inner DO loop increments the indices axially to repeat the identical section geometry for the remaining downstream panels on the body interference shell. The panel properties are laid out starting at the bottom for the left hand side. All quantities defined maintain the same definitions and conventions used in BLYOUT for the circular fuselage.

Called by LDCALC

#### A-7 Subroutine BODPAN

Subroutine BODPAN organizes the calculation of the revised axial spacing for noncircular fuselage source panels. The starting locations in blank common of all arrays used to define the geometric properties of the panels are computed. The routine

loops on the number of body segments used to specify the body shape. Subroutine BODPN2 is called for each of NFUS segments to calculate the revised axial spacing on the body and the body panel geometry. If more than one segment exists, the revised meridional spacing geometry, YB and ZB, are read from TAPE8. At the end all geometric arrays in blank common are saved on TAPE7. The optional print of source panel control point coordinates, inclination angles and areas are performed here. A listing of this routine is found in Figure A-1(e) of this report.

See the discussion in Appendix B, Section B-3 regarding item 2 in Figure A-2 for the equivalent dimension of blank common at this point. The starting location indices defined in BODPAN and saved in labeled common DIMENS are

IXPT=1

IYPT=IXPT+NBODY

IZPT=IYPT+NBODY

ITH=IZPT+NBODY

IDEL=ITH+NBODY

IAR=IDEL+NBODY

IYC(IFU) = IAR+KX+KFORX(1) \* KRADX(1) + . . . + KFORX(IFU) \* KRADX(IFU)

IZC(IFU) = IYC(IFU) + KXKR

Subroutine references

IOREAD, BODPN2, IOWRIT

Called by

**GEOM** 

#### A-8 Subroutine BODPN2

Subroutine BODPN2 performs the revision of the axial spacing on noncircular bodies and computes the body panel geometry of a

single segment. The x, y, and z coordinates of the cross sections of a segment are passed through the argument list as arrays. A listing of the routine is presented in Figure A-l(f) of this report.

The body panel geometry is established by a linear interpolation along body meridian lines of the y and z coordinates at the new axial stations. The interpolation is started with the first ring of panels in a segment and continued until the last ring of panels on the last segment is reached. The corner point coordinates, the control point coordinates, the inclination angles, and area are calculated for each panel in sequence. The calculation of the latter quantities are performed in routine PANEL from corner point information.

The panel control point coordinates, the panel dihedral angle  $\theta$ , the panel incidence angle  $\delta$ , the corner point coordinates and the panel areas are returned through the argument list to BODPAN where they are stored in blank common. Finally if the print option IPRT(2) $\neq 0$ , the corner point coordinates are written on the output file.

## Argument list

JP	panel number
XB (M)	x station of external geometry for Mth section
	in segment
XJ(J)	x station of revised axial spacing for Jth
	section in segment
YB(M,K),	y and z of external geometry for Mth section in
ZB(M,K)	segment and Kth meridional station
XYZ(JP,1),	XPT, YPT, and ZPT arrays of the $x$ , $y$ , and $z$
XYZ(JP,2),	coordinates of the control paints of JPth
XYZ (JP, 3)	panel
XYZ (JP, 4)	dihedral angle THET of the JPth panel

XYZ(JP,5) incidence angle DELTA of the JPth panel

XYZ(JP,6) area of JPth panel

XC(J) corner points of panels at Jth axial station

YC(J,K), y and z corner points of panels at Jth axial

ZC(J,K) station and Kth meridional angle

NFUSOR number of external geometry stations on segment

KRAD number of meridan lines on segment

KFUSOR number of panel revised axial stations

NBODY total number of body panels

IPRT array of print controls

Subroutine references

PANEL

Called by

BODPAN

#### A-9 Subroutine BODVEL

Subroutine BODVEL organizes the looping through source panels to define corner geometry and compute panel influence coefficients. BODVEL loops through the number of source panels on each ring in the given body segment to set up the local panel corner coordinates. A listing of this routine is presented in Figure A-l(f) of this report.

The influence coefficients for each panel on all remaining panels is set up and computed in PANVEL. The influence coefficients are then generated for one ring of body panels on another ring. For each such block of coefficients, the influence normal to the panel and each of the three component velocities, u, v, and w, are saved. The block of normal coefficients is saved on TAPE9. If the coefficients correspond to a diagonal block in the total coefficient matrix (i.e. the influence of a ring on itself) the

L\*U triangularization of the block is performed by PASOO1 for later calculation use. In supersonic flow it is assumed that aft rings of panels have no influence on upstream panels. All blocks of coefficients above the diagonal blocks are thus assumed to be zero and not computed.

The descriptions of the variables in the argument list follow

XPT, YPT, ZPT	coordinates of panel control points
THET	array of panel inclination angles at control points
DELTA	array of panel incidence angles
AN	temporary array to contain the normal velocities
	to control point I
UB(1,IJ),	arrays of velocity components, u,v,w, at
UB(2,IJ),	control points in body coordinate system
UB(3,IJ)	
XC	x coordinates of leading and trailing edges of
	panel rings of segment
YC, ZC	y and z coordinates of body panel corner points
	of segment
KFUSOR	number of axial stations defining segment
IFU	segment index
IXZSYM	body XZ plane of symmetry indicator

Subroutine references
IOWRIT, PANVEL, PASO01

Called by VELCMP

#### A-10 Subroutine BSHOCK

Subroutine BSHOCK computes the nonlinear shock wave shape emanating from the store or fuselage nose produced by an arbitrary body at angle of attack along a given meridian, PHIS(J). Three options are available depending on the value of NSHOCK (input items 14 or 61) for the choice of where the meridional traverses are made. Single traverses, evenly distributed traverses, and user specified locations may be used to define polar shape of the shock wave. A listing of the routine is presented in Figure A-1(g) of this report.

The methods used to generate the nonlinear position of the shock wave along a single traverse are developed in Section 4.1.2 of Reference 3. Use is made of the work of Reference 2. The axial scan for the maximum radial velocity behind the linear shock wave is computed for a fixed interval equal to half the distance from the nose to the body shoulder. This approximate interval must be used to account for the saw tooth behavior of the velocity field. The three-dimensional effects associated with angle of attack are accounted for by two means. In computing the local radial velocities along a traverse, the perturbation components must be rotated into wind axes to avoid including angle of attack components directly in the radial velocities as follows

$$u_{w} = u_{s} \cos \alpha_{c} - v_{s} \sin \alpha_{c} \sin \phi_{R} + w_{s} \sin \alpha_{c} \cos \phi_{R} + 1.0$$
 (A-2)

$$v_{w} = v_{s} \cos \phi_{R} + w_{s} \sin \phi_{R} \tag{A-3}$$

$$w_{w} = -u_{s} \sin \alpha_{c} - v_{s} \cos \alpha_{c} \cdot \sin \phi_{R} + w_{s} \cos \alpha_{c} \cdot \cos \phi_{R}$$
 (A-4)

and second, the assumption the Mach cone rotates rigidly about the body with angle of attack is modified in accordance with reference 2 as follows.

where  $\theta$  is the shock angle propagating from the nose,  $\theta_{S}$  is the nose limited shock angle at zero angle of attack,  $\alpha_{C}$  is the included angle of attack,  $\epsilon_{\alpha}$  is Mach number and nose cone angle dependent correction from Reference 2, and  $\phi$  is the polar angle around the cone of the traverse. Tables of RSHK and XSHK for each of the polar traverses are the primary output of this routine.

This routine is used in two ways. For the fuselage, the shock shape is computed at the angle of attack of the body. The traverses are computed over the entire field of interest and include the corrections for angle of attack. For the stores, the shock shape is computed at zero angle of attack for only the first quadrant. The remaining shape is derived from symmetry. The angle of attack correction of Equation (A-5) is then applied to the zero angle of attack shape for the local conditions of each of the elliptic stores.

The descriptions of the parameters of the argument list are as follows:

RINIT minimum radius at which shock shape search is

initiated

PHISHK for NSHOCK=0, angle at which shock shape is

generated

spacing

THSHK limiting shock wave angle at nose measured from

x-axis,  $\theta_s$ 

Subroutine references FLDVEL

Called by WDYBDY, STORIO

#### A-11 Subroutine CONFIG

Subroutine CONFIG is used to input the geometrical description of the external shape of the noncircular fuselage or elliptic stores. A listing of the routine is presented in Figure A-1(i) of this report. The routine first reads the configuration reference area from the input file if  $J0\neq 0$ , otherwise the reference area is set equal to unity.

If  $J2\neq0$ , the body external geometry data is read from the input file according to the specified body option for each of NFUS body segments. For arbitrary cross-sections, the y and z ordinates of the body segment are read. For circular or elliptic sections, the particular combination of body area, radius, semi-major or minor axes, or elliptic ratio requested may be read.

In addition, the area at each axial station is computed. The maximum cross-section area is also saved. The description of the single argument is as follows:

SFUS array to hold the y and z ordinates of the arbitrary cross-section data for J2=1

Subroutine references
ASECTN

Called by GEOM

#### A-12 Subroutine DOUBLT

Subroutine DOUBLT calculates coefficients used in the determination of the line doublet strengths. They occur as terms in Equations (I-27) and (I-28) of Reference 1. The relation of the coefficients to perturbation velocities,  $u_{B,d}/V_{\infty}$  and  $v_{B,d}/V_{\infty}$ , induced by a number of line doublets distributed along the body centerline is shown in the first two of Equation (I-30) in which the coefficients occur as the multipliers of  $K_{d,n}\cos\theta$ . A listing of the subroutine is presented in Figure A-1(j) of this report. Section I-2.2 of Reference 1 should be referred to for further details concerning the doublet strength calculations.

For a specified control point,  $x_B$ ,  $r_B$ , and singularity origin  $\xi$ , the subroutine calculates quantities U and V according to the following equations.

$$U = \beta \sqrt{\left(\frac{x_B - \xi}{\beta r_B}\right)^2 - 1}$$
 (A-6)

$$V = -\frac{\beta^2}{2} \left[ \cosh^{-1} \left( \frac{x_B - \xi}{\beta r_B} \right) + \left( \frac{x_B - \xi}{\beta r_B} \right) \sqrt{\left( \frac{x_B - \xi}{\beta r_B} \right)^2 - 1} \right]$$
 (A-7)

At the beginning of the subroutine a test is performed to determine if the control point is ahead of the Mach cone from the doublet origin. If so, U and V are set to zero and control is returned to the calling program.

The following table of definitions contains most of the variable names used in the subroutine:

Called by BDYGEN

#### A-13 Subroutine DPCOEF

Subroutine DPCOEF calculates the coefficient matrix of the set of simultaneous boundary condition equations which are to be solved for the constant u-velocity panel singularity strengths. A listing of the subroutine is presented in Figure A-1(k), and a flow chart in Figure A-5 of this report.

The elements of the matrix are the aerodynamic influence coefficients described in Section 3.3.4 of Reference 3. They occur indirectly in the summation terms in the left-hand side of Equations (24), (25), and (26) of that reference. The actual coefficients which the subroutine calculates, FVN( $\nu$ ,n), are related to the summation terms through the panel strengths,  $u_{+n}/V_{\infty}$ , by the following equations in which n is the index of the influencing panel and  $\nu$  is the control point index:

$$\frac{\mathbf{w}_{\mathbf{w}_{\mathbf{v},\mathbf{n}}}}{\mathbf{v}_{\mathbf{w}}} \cos \phi_{\mathbf{v}} - \frac{\mathbf{v}_{\mathbf{w}_{\mathbf{v},\mathbf{n}}}}{\mathbf{v}_{\mathbf{w}}} \sin \phi_{\mathbf{v}} = \frac{\mathbf{u}_{\mathbf{n}}}{\pi \mathbf{v}_{\mathbf{w}}} \text{ FVN}(\mathbf{v},\mathbf{n}) \qquad \mathbf{v} = 1,2,\dots \text{NPANLS}$$

$$\frac{\mathbf{v}_{\mathbf{w}_{\mathbf{v},\mathbf{n}}}}{\mathbf{v}_{\mathbf{w}}} = \frac{\mathbf{u}_{\mathbf{n}}}{\pi \mathbf{v}_{\mathbf{w}}} \text{ FVN}(\mathbf{v},\mathbf{n}) \qquad \mathbf{v} = \text{NIP}, \text{NIP+1},\dots \text{N2}$$

$$\frac{\mathbf{v}_{\mathbf{v}_{\mathbf{v},\mathbf{n}}}}{\mathbf{v}_{\mathbf{w}}} = \frac{\mathbf{u}_{\mathbf{n}}}{\pi \mathbf{v}_{\mathbf{w}}} \text{ FVN}(\mathbf{v},\mathbf{n}) \qquad \mathbf{v} = \text{N2P}, \text{N2P+1},\dots \text{NPTOT}$$

for  $n = 1, 2, \dots, NPTOT$ .

The subroutine consists of three double DO loops. The first loop uses subroutine VELWP1 to calculate the influence of the wing panels at the wing, pylon, and fuselage control points. The second loop is bypassed if there is no pylon, NPY=0. If a pylon is present, the influence coefficients for the pylon panels are calculated by means of subroutine VELPP1. The third double loop is bypassed if there is no fuselage, NFU=0. Otherwise, the influence coefficients for the fuselage panels are calculated using subroutine VELBD1.

Within each outer loop are three inner loops in series, which fix the control point location on the wing, pylon, or fuselage, respectively. On the flow chart, only the first occurrence of the first inner loop is shown in detail, which includes the call to subroutine VELWP1. The remaining inner loops have the same logical structure and are not shown.

If the control point is located on a wing or a fuselage panel, the influence coefficient is the component normal to the panel surface at the control point. Thus, the wing coefficients are rotated through the panel dihedral angle using quantities previously calculated in subroutine WLYOUT. The fuselage coefficients are rotated through the panel orientation angle using quantities calculated in subroutine BLYOUT.

Subroutine references VELBD1, VELPP1, VELWP1

Called by LDCALC

#### A-14 Subroutine DPRHS

Subroutine DPRHS calculates the right-hand side vector of the set of simultaneous boundary condition equations which are to be solved in order to determine the constant u-velocity panel singularity strengths. The boundary conditions are specified in Equations (24), (25), and (26) of Reference 3. A listing of the subroutine is presented in Figure A-1(k) and a flow chart in Figure A-6 of this report.

The major portion of the subroutine is devoted to evaluating the externally induced perturbation velocities,  $u_{w_1,\nu}/v_{\omega}$ ,  $v_{w_1,\nu}/v_{\omega}$ , and  $w_{w_1,\nu}/v_{\omega}$ , at all of the wing, pylon, and fuselage control points.

The first section calculates velocities induced at wing and pylon control points by the circular fuselage line sources, sinks, and line doublets if a circular fuselage is present (NFU=1). A control point is located in the fuselage coordinate system and subroutine VELCAL is called to calculate the velocities at this point. These velocities are summed in the UEI, VEI, and WEI arrays.

The next section calculates velocities induced at wing and pylon control points by the noncircular fuselage source panels if a noncircular fuselage is present (NFU=2). Data for the fuselage are first restored to blank common from TAPE10 through FRSTRT and indices defining the beginning of the various arrays are defined. All of the wing and pylon control points are then located in the fuselage coordinate system. The velocities at these points are calculated by calling subroutine FLDVEL.

Next, the perturbation velocities induced by the wing and pylon thickness source panels are calculated by means of subroutines VELWT1 and VELPT1. The effects included are wing

source panels on wing, pylon; and fuselage control points and pylon source panels on wing and fuselage control points. If a pylon is not present, NPY=0, or the fuselage is not present, NFU=0, calculations involving the pylon or the fuselage are omitted.

The last three loops in the subroutine calculates the right-hand sides of the equations. If the pylon is located below the fuselage centerline, CENTER=TRUE, VEI is set to zero for all pylon control points.

It should be noted that if the control point is located on the wing or on the fiselage, dihedral effects are included in calculating the velocity normal to the panel surface.

Subroutine references
FLDVEL, FRSTRT, VELCAL, VELPT1, VELWT1

Called by LDCALC

#### A-15 Subroutine FLDVEL

Subroutine FLDVEL is used to organize the computation of the u, v, w velocity components at the field points XFP, YFP, ZFP. This routine initializes all velocities to zero and computes the locations of the required geometric and strength arrays in blank common for the fuselage or store at hand. If the configuration models the fuselage with inlets, variable INLET is initialized to TRUE to indicate presence of inlet panels. It then performs the looping for the number of segments and the number of rings in each segment to sum the component velocity contributions at each field point. A listing of the routine is presented in Figure A-l(m) of this report.

The descriptions of the parameters in the argument list follow:

XFP, YFP, ZFP	arrays of coordinates of field points in coordinate
	system of body panels at which component velocities
	are computed
SVN	temporary array of length NFLD used to test for
	zero influence at field point
LSKP	temporary logical array of length NFLD used to test
	for zero influence of ring of panels at field point
U,V,W	arrays of component velocities computed for
	influence of body at field points
NF LD	number of field points
ID	array containing the same variables in the same order
	as in common DIMENS
IG	index specifying IGth strength solution, GB, to
	be used

Subroutine references FLDVL2

Called by BSHOCK, DPRHS, INLSHK

# A-16 Subroutine FLDVL2

Subroutine FLDVL2 computes the three components of velocity induced at specified field points by the source panels of a given ring of body panels. The field point is assumed to have no incidence or inclination relative to the flow. A listing of the routine is presented in Figure A-l(m) of this report.

The routine first initializes the field point inclination and incidence transformations to zero. For each of the influencing

panels on a ring the control point coordinates, inclination and incidence angles and corner points in the local panel system are defined. For each panel  $\beta_\ell$  is initialized to  $\beta_0$ . For panels used to model inlet openings  $\beta_\ell$  is set to the minimum of  $\beta_0$  and BTINLT. Further, if an inlet panel slope exceeds BTINLT,  $\beta_\ell$  is set to 0.99/tan $\delta$ . For each of the field points the influence of the panel on the field point is computed, multiplied times the panel strength and summed.

To minimize computational time FLDVL2 tests whether each ring of panels contributes to the total velocity at a given field point. For each point the following sum is made for each panel on the ring

$$SVN(I) = UB^2 + VB^2 + WB^2$$

where JB, VB, WB are the influence coefficients of a panel at the Ith field point. If the net influence for a complete ring SVN is equal to zero the logical variable LSKP(I) for that field point is set .TRUE. and all further calculations at that point are suppressed. This is based on the assumption that at supersonic speeds once a point is ahead of the Mach waves from a ring, the influence of that ring and all subsequent rings will vanish.

The descriptions of the parameters in the argument list follow:

XPT,YPT,ZPT arrays of the coordinates of the source panel control points for the entire body

THET array of inclination angles for panels

DELTA array of incidence angles for panels

GB array of panel strengths

XFP,YFP,ZFP arrays of coordinates of field points

U,V,W arrays of orthogonal velocity components at panels in x, y, and z directions

SVN	temporary array used to test influence of ring
	on point
LSKP	temporary array used as logical indicator of no
	further influence at point
NFLD	number of field points
XC, YC, ZC	arrays of coordinates of panel corners for
	segment
KFUSOR	number of axial station bounding panels in
	segment
IXZSYM	body symmetry indicator
JR	number of panels in ring J
JG	starting offset index of first panel in ring
L	index of trailing x-station in segment

Subroutine references PANVEL, INLTST

Called by FLDVEL, IMAGEV

# A-17 Subroutine FRSTRT

Subroutine FRSTRT is used to save or restore required program information for the source paneling method to restart a configuration analysis. The routine is set up to allow storage of the information from more than one configuration on the same file. A listing of the routine is presented in Figure A-1(n) of this report. Six options are available based on the information to be stored or retrieved and where the information is to reside. They and the functions they perform are

KODE	DESCRIPTION
1	saves control integers and arrays in blank common
2	restores control integers and arrays in blank common

- 3 saves above information and AIC, U, V, and W velocity matrices
- 4 restores above information and AIC, U, V, and W velocity matrices
- restores control integers and arrays stored under either option 1 or 3 into starting core location in blank common. All arrays are copied into blank common rather than into original labeled commons
- for restores information in manner of KODE=5 and reads past velocity matrices stored under option 3 to position file at next record

The information saved under KODE=1 consists of all the variables in labeled commons DIMENS, PARAM, BOPTNS, BGEOM, HEAD, and BSHOCK, and the first NTAP7 variables in blank common. The later set are also saved on TAPE7. If the configuration contains an inlet, the variables in common BINLET and BINSHK are also saved. In copying the velocity matrices under KODE=2, the arrays are first copied from TAPE8 or TAPE9 into temporary arrays in blank common and then onto the output file IO. The last two options are used in Program II to stack multiple configurations end-to-end in blank common. Provision has been made for only one configuration with an inlet. Variables from commons BINLET and BINSHK are copied back into those arrays under all KODE options. During this data retrieval three indices used to locate the control variable arrays are saved.

- IDO (=LASTA+1) first location in blank common of variables contained in labeled commons DIMENS, PARAM, BOPTNS, BGEOM, and TITLE in order
- ISKO (=IDO+571) first location in blank common of variables contained in labeled common BSHOCK

IAO (=ISKO+240) first location in blank common of geometric and strength arrays previously saved on TAPE7

The descriptions of the parameters in the argument list are:

is stored or retrieved in unformatted form

KODE optional index selecting information to be read or written to file IO; see above descriptions

LASTA last location in blank common currently defined

Subroutine references IOREAD, IOWRIT

Called by

WDYBDY, STORIO, DPRHS, WRFILE

### A-18 Subroutine FUSEIO

Subroutine FUSEIO reads and prints the input data which describe the circular fuselage (NFU=1) and calculates the line source and doublet distributions as described in Appendix I of Reference 1. A listing of the subroutine is presented in Figure A-1(o) and a flow chart in Figure A-7 of this report.

The subroutine first reads in and prints input items 5, 6, 7, and 8 which consist of the fuselage length, the maximum radius, and the polynomials specifying the fuselage shape. Next, the data used to lay out the body interference panels, input items 9 and 10, are read and printed. Subroutine BDYGEN is then called for the purpose of calculating the source and doublet distributions. The fuselage shoulder location is next found and finally

subroutine SHKSHP is called to calculate the nose shock wave shape.

Subroutine references BDYGEN, SHKSHP

Called by LDCALC

#### A-19 Subroutine GEOM

Subroutine GEOM organizes the reading of the noncircular body input and the calculation of the source panel geometry arrays. This routine is used to input both the noncircular fuselage and the elliptic store panel geometry. A listing of the routine is presented in Figure A-l(p) of this report.

The specification of the input describing the body paneling is split in two phases by GEOM. In the first phase the control parameters and the geometric arrays describing the external shape of the body are read. The external geometry arrays are read by a call to CONFIG. This geometry defines the external shape independently of the paneling used. It may optionally be used to specify panel corner coordinates. In the second phase the control parameters, additional arrays and inlet data required are read which define the subdivision of the external shape into panel coordinates. The routine NEWRAD is called to perform the interpolation necessary to redefine the meridional spacing of the panels. The routine BODPAN is called to perform the interpolations for new axial spacings of panels and to calculate control point coordinate and inclination information.

This routine also computes the number of panels to be generated and the allocation of array space in blank common to be used. The total number of axial stations, meridional angles used to

define panel corners and the total length of blank common required are compared against dimensioned values as check on input problem size.

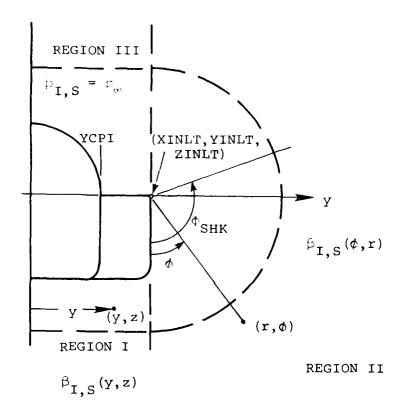
Subroutine references
BODPAN, CONFIG, NEWRAD

Called by WDYBDY, STORIO

### A-20 Subroutine INLSHK

Subroutine INLSHK computes the nonlinear shock wave shape emanating from a ramp type inlet shown in Figure 12 of Volume II. The table of shock locations is produced in a manner analygous to that used in BSHOCK to generate the shock shape about the body nose with the exceptions that only the influence of the modified panels across the inlet are felt and the shock propagates from the leading edge of the ramp. The detailed explanation of the inlet shock is presented in Section 4.4.2 of Reference 3. A listing of the routine is presented in Figure A-1(r) of this report.

The generation of the traverses used to locate the first influence and integrate the nonlinear shape uses the same model and equations detailed for BSHOCK. Additional assumptions are made about the body in generating the traverses regarding the shape of the ramp inlet. Field points aft of the inlet are assumed to lie in the three regions relative to XINLT, YINLT, ZINLT as shown in the following sketch.



In region I inside and below the inlet, traverses are carried out parallel to the XZ plane with subsequent interpolation in the y-direction to find the first inlet shock influence,  $\beta_{I,S}$ . In region II, outboard of the inlet, traverses are calculated along radial lines from (XINLT,YINLT,ZINLT) from  $\varphi=0^{\circ}$  to  $\varphi=\varphi_{SHK}$ . The last traverse at  $\varphi=180^{\circ}$  is assumed such that  $\beta_{I,S}=\beta_{\infty}$ . In region III inboard and above  $\varphi_{SHK}$  for the inlet, the flow is assumed equal to free stream for which  $\beta_{I,S}$  is set to  $\beta_{\infty}$ .

NIS shock traverses are generated alternating first in Region I and then in Region II to define the inlet shock location. The shocks propagate from a starting point at (XINLT, y, ZINLT) along a line at the angle  $\xi$  from the vertical plane. The first shock is positioned at y=YINLT and  $\varphi=0^{\circ}$ . The second traverse propagates

from y=YINLT at  $\phi$ =PHISHK. The third propagates from y=0 at  $\phi$ =0°. The fourth is at y=YINLT and  $\phi$ =45° and the fifth is at y=YCPI and  $\phi$ =0°. Additional traverses are laid out by subdividing region I between y=0 and y=YCPI and region II between  $\phi$ =0 and  $\phi$ =PHISHK with even increments.

The following are differences in the calculative procedure for the inlet and the nose shock shape. In scanning in the axial direction at a given Y,Z location, all values are referenced to XINLT, YINLT(IRAD), and ZINLT. In computing the influence at field points the strengths of all panels except those designated as open or blocked inlet panels and additional adjacent panels on the inlet aft of the opening are set equal to zero. integrating the traverses, no angle equivalent to the nose limiting shock angle,  $\theta_{c}$ , is used. When estimating the shock location below the inlet in region I in the presence of partial blockage (mass flow ratios less than one), the shock is assumed to follow BTINLT down the inlet face to the first blocked panel. A normal shock is assumed to exist moving the shock vertically down to the lower lip of the cowl. For the first step, thereafter, in the radial direction, the  $\beta_{\text{T.S}}$  propagating from the inlet is set equal to the first computed value. The only restriction is that it be positive.

The description of the parameter in the argument list follows:

PHISHK maximum meridional angle about YINLT, ZINLT to which shock shape is calculated on even spacing

Subroutine references FLDV2L, INLTST

Called by WDYBDY

### A-21 Function INLTST

Logical function INLTST determines whether the panel index in the argument is for an inlet panel. The value of the function is set to TRUE if the index is for an inlet panel and FALSE if it is not. In addition the logical variable OPEN is set to indicate whether the inlet panel is blocked or unblocked to flow. Three conditions are tested for. If no inlet panels exist INLTST and OPEN are set false. If an inlet panel exists the index I is compared to the table of possible inlet panel numbers, JINLT. If I is equal to one of the inlet panel numbers, INLTST is set true. If I is not an inlet panel number, INLTST is set false. If I falls in the subset of JINLT of unblocked panels, OPEN is true; otherwise OPEN is set false. A listing of this routine is presented in Figure A-1(t) of this report.

The description of the parameters in the argument list follows.

I panel number index to be compared with table of possible inlet panel numbers, JINLT

OPEN logical variable indicating whether an inlet panel is open or blocked. OPEN is TRUE if panel allows unblocked flow through panel

Called by

BODVEL, FLDVL2, PANEL, SOLVE

# A-22 Subroutine INLXYZ

Subroutine INLXYZ scans the X,Y,Z coordinates of the inlet panel corners to find the coordinates to be used to define inlet

leading edge, lower cowl lip, and first axial station containing blocked panels. Nine values are computed. They correspond to the most outboard leading edge of the inlet panels, XINLT, YINLT, ZINLT, the most aft outboard trailing edge of the inlet panels, XINLTE, YINLTE, ZINLTE, the innermost y station of the inlet, YCPI, and the first axial station of blocked inlet panels, XCLOSD. If no inlet blockage exists, this value is set to inlet trailing edge XINLTE. In addition, the inlet mass flow ratio is computed from the ratio of exposed open frontal area of inlet panels,  $A_{\rm open}$ , to total inlet frontal area,  $A_{\rm total}$ . The mass flow ratio RVIVO is set equal to  $A_{\rm open}/A_{\rm total}$ . This routine is called once for each inlet panel. A listing of the routine is presented in Figure A-1(t) of this report.

The descriptions of the parameters in the argument list follow.

XIN, YIN, ZIN coordinates of corner of inlet panel to be

checked

FAREA frontal area of panel

OPEN logical variable indicating whether an inlet panel

is open or blocked. OPEN is TRUE if panel allows

unblocked flow through panel

Called by PANEL

#### A-23 Subroutine INVER1

Subroutine INVER1 solves the system of simultaneous linear algebraic equations.

 $\int A 1 \overline{X} = \overline{B}$ 

This routine performs pivot searching during the solution of the general matrix, A. The right hand side is passed into INVERL as

the N+1'st column in the matrix. The solution, X, also returns in that location. A listing of this routine is presented in Figure A-1(u) of this report. The routine is currently limited to 200 equations by internal dimensions. The descriptions of the parameters in the argument list follow.

A coefficients of linear system of equations in first N columns; columns N+1 through N+NSYS contain multiple right-hand sides, B, on input and solutions, X, on return

NSYS number of right hand sides
N actual number of equations

NMAX first dimension of A MMAX second dimension of A

Called by LDCALC

#### A-24 Subroutine IOREAD

Subroutine IOREAD performs an unformatted read from external file, IO. NA consecutive elements of array, A, are read sequentially. This routine is used to specify a common interface to external files. A listing of this routine is presented in Figure A-1(u) of this report. The descriptions of the parameters in the argument list follow.

IO external file reference number

A array of numbers to be read

NA number of elements of A to be read

A machine dependent version of IOREAD is available for CDC machines using input routine BUFFER IN by appropriate replacement of comment cards within the routine.

Called by

BODPAN, VELCMP, SOLVE, SMARCH, FRSTRT

### A-25 Subroutine IOWRIT

Subroutine IOWRIT performs an unformatted write to external file, IO. NA consecutive elements of array, A, are written sequentially. This routine is used as a common interface to external files. A listing of this routine is presented in Figure A-1(u) of this report. The descriptions of the parameters in the argument list follow:

A array of numbers to be written

NA number of elements of A to be written

A machine dependent version of IOWRIT is available for CDC machines using output routine BUFFER OUT by appropriate replacement of comment cards within the routine.

Called by

BODPAN, VELCMP, SOLVE, NEWRAD, FRSTRT, BODVEL

## A-26 Subroutine NETCLC

Subroutine NETCLC calculates the net corner strengths for a given set of wing, pylon, or fuselage constant u-velocity or thickness panels. The net strength for a corner point is calculated by superposing the strengths of the four panels surrounding the point. Whenever a corner point lies on an exterior boundary or along a chordwise row where a break in sweep angle or dihedral angle occurs, surrounding panels are assumed to be present with zero strengths. The superposition scheme is

described in Section 3.3.7 of Reference 3. A listing of the program is presented in Figure A-1(v) of this report.

---

The panel strengths are passed to the subroutine as formal parameters in the array S, which is dimensioned NCW by MSW. The subroutine first stores this array in a new array P, leaving the first and last columns zero and inserting a zero column whenever a break in leading-edge or trailing-edge sweep angle or dihedral angle occurs. The polar angle acts as dihedral angle for a body interference panel. The first and last rows of P are also set to zero. These zero elements of array P correspond to panels of zero strength mentioned above.

The rest of the subroutine consists of a double DO loop in which the net corner strengths, DP, are calculated according to the following relation:

$$DP(I,J) = P(I,J) - P(I+1,J) - P(I,J+1) + P(I+1,J+1),$$

$$I = 1, NCW + 1$$

$$J = 1, MSW + k + 1$$
(A-8)

where k is the number of breaks in sweep or dihedral which occur over the specified set of panels.

The descriptions of the parameters in the argument list follow:

S	array containing the NCW*MSW panel strengths
DP	array containing the NCW1*MSW1 net corner strengths
NCW	number of panels in a chordwise row; also row
	dimension of S
NCW1	NCW+1; row dimension of DP
MSW	number of panels in a spanwise row on wing or
	pylon; number of panels in a ring of fuselage panels
MSW1	MSW+1

number of corner points in a spanwise row of wing or pylon panels; number of corner points in a ring of fuselage panels

PSILE array containing leading-edge sweep angles for wing or pylon, polar angles for fuselage panels

PSITE array containing trailing-edge sweep angles for wing or pylon, polar angles for fuselage panels

PHI array containing dihedral angles for wing, polar angles for fuselage; zero array for pylon

Called by NULYT

### A-27 Subroutine NEWRAD

Subroutine NEWRAD is used to organize the revision of the noncircular body meridian line spacing for the source panels. This routine computes the number of meridional lines to be used for paneling on the half or full body. The allocation of arrays to be used for temporary storage, YB and ZB, are defined also. NEWRAD calls NEWRD2 for the revised meridional spacings for each of the NFUS body segments. If more than one segment exists, the revised ordinates, YB and ZB, are written on external file number 8. A listing of this routine is presented in Figure A-l(v) of this report.

Subroutine references IOWRIT, NEWRD2

### A-28 Subroutine NEWRD2

Subroutine NEWRD2 computes the revised noncircular body meridional line spacing of a given body segment. For each

segment, there are three options for redefining the meridian lines and the option to define the symmetric portion of a body. If KRAD=0, the meridian lines are not changed. If KRAD is positive, the meridian lines are relocated at KRAD equally spaced values of the meridian angle  $\vdots_k$ . If KRAD is negative, the user defined values of  $\vdots_k$  are used. For each of the above options, new meridian lines may be defined from circular, elliptic, or arbitrary section input. A listing of this routine is presented in Figure A-1(v) of this report.

If the body has circular or elliptic cross section, the y and z coordinates are calculated at each station as follows:

$$y = r \cos i$$
  
 $z = z_c + r \sin i$ 

where  $\mathbf{z}_{\text{C}}$  is the camber offset in item 19 of the input and the local radius  $\mathbf{r}$  is defined as

$$r = \frac{1}{\sqrt{(\cos\phi/BY)^2 + (\sin(AZ)^2}}$$
(A-16)

The parameters BY and AZ are the horizontal and vertical semi-axis of the ellipse. For the circular body, BY and AZ are equal to the radius and the above equation reduces to the circular radius.

If the body has an arbitrary cross section, the y and z coordinates are obtained by linear interpolation at the new values of of the original y and z coordinates read in the program input items 20 and 21.

If the symmetry option is used, IXZSYM=1, the remaining coordinates for the second half of the body are defined. The meridian lines for the symmetric half of the body continue in counterclockwise fashion about the body. The y ordinates are the

negative of the first half of the body, while the z values remain the same.

The descriptions of the parameters in the argument list follow:

YB,ZB	y and z ordinates of the revised meridional
	spacing
PHIK(K)	: k, Kth revised meridian for new spacing, deg.
ZFUS(N)	$\mathbf{z}_{_{\mathbf{C}}}$ , camber offset of centerline at Nth axial
	station of segment
FUSBY(N),	BY and AZ, horizontal and vertical semi-axes of
FUSAZ(N)	ellipse at Nth axial station of segment
SFUS	array containing y and z for arbitrary cross
	section input option
NFUSOR	number of axial stations of segment
KRAD	number of meridian lines of revised spacing
NRAD	number of meridian lines of original input spacing
IXZSYM	symmetry option

Called by NEWRAD

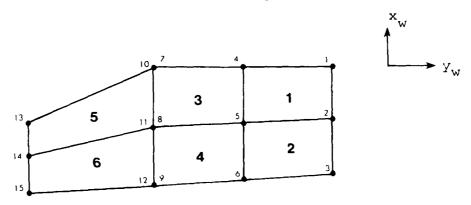
#### A-29 Subroutine NULYT

Subroutine NULYT selects a subset of constant u-velocity and wing and pylon thickness panel layout data to be saved as an input iata set for Program II. The subroutine also calculates and saves the net strengths associated with each panel corner. A listing of the subroutine is presented in Figure A-1(w), and a flow chart in Figure A-8.

The data stored in the new arrays describe a grid of corner points representing the panel layout, thus eliminating some duplication. For example, a corner which is the junction of four

panels is specified four times in the panel coordinate arrays, only once in the corner system. Similarly, the slope of the boundary of two panels adjacent in a chordwise row is saved only once in the new arrays. However, whenever a break in sweep or dihedral angle occurs, an extra chordwise row of points must be saved to accommodate the velocity calculations to be performed in Program II.

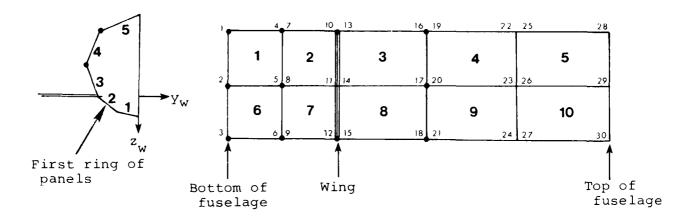
At the beginning of the subroutine indices needed to describe the new arrays are calc lated. Next, as the flow chart indicates, data is stored for constant u-velocity panels on the wing. The sketch below illustrates the corner numbering convention as employed for a wing with one leading-edge sweep break and six panels. Panel numbers are in the center of the panels.



For each chordwise row of points, the variables YPT, ZPT, SPHI, CPHI are stored only once. Variables XPT and SWP are stored for all points. The slope and dihedral values used correspond to panels to the left of the points, except for an extra row of points which occurs at a break in sweep or dihedral. For this type of chordwise row (points 7,8,9 in the above sketch), SPHI, CHPI, and SWP correspond to panels to the right.

If a pylon is present, the subroutine next stores the corner data for pylon panels. These data are stored in the same arrays

following the wing corner data. Similarly, if a fuselage is present, the corner data for the fuselage panels is saved in arrays following the wing and pylon data. The correspondence between body interference panels and corner point numbering is shown in the ketch below in which NBDCR1=3, NBDCR2=2. One should note that an extra row of points is saved for each chordwise row of panels.



The subroutine next stores the data for wing and pylon source panels, using the same procedure as for wing and pylon constant u-velocity panels. However, the source panel data are stored in separate arrays.

The last section of the subroutine calculates, by means of subroutine NETCLC, the net strength associated with each corner point. Finally at the end of the routine, a factor of  $\pi$  which had been removed from the source panel thickness slopes for boundary condition calculations, is restored.

Subroutine references NETCLC

Called by LDCALC

#### A-30 Subroutine PANEL

Subroutine PANEL's purpose is to calculate direction cosines of the normal vector and the centroid, area, and inclination angles of an arbitrary quadrilateral panel. It is called to compute the geometric properties of each source panel on the noncircular body. A listing of the routine is presented in Figure A-1(y) of this report.

The four corners of the panel are numbered in a clockwise direction. A diagonal vector  $T_1$  connects points 1 and 3, and a diagonal vector  $\mathbf{T}_{2}$  connects points 2 and 4. The normal vector N is obtained by taking the cross product of these diagonal vectors, and the direction cosines determined by calculating the projections of this vector in the body reference coordinate system. The plane of the panel is defined to be perpendicular to the normal vector and to pass through a point whose coordinates are the averages of the coordinates of the four input points. The input points are then projected into the plane of the panel, and transformed to the reference coordinate system. A new panel coordinate system  $\xi_{\bullet}\eta_{\bullet}$  is introduced with the average point of the panel as origin. The coordinates of the centroid and the panel area are calculated in this new system, and the centroid transformed to the reference system. angles are used to define the panel orientation. The incidence  $\delta$  is the angle between the x axis and the line of intersection with the panel of a plane passing through the x axis and perpendicular to the panel. The inclination  $\theta$  is the angle between the y axis and the line of intersection of the panel with the yz plane. These two angles are calculated in terms of the direction cosines of the normal vector.

The descriptions of the parameters in the argument list follow:

J panel row number

K panel column number

NP panel number

XYZ(NP,1), array containing vectors of control points, XPT,

XYZ(NP,6) YPT, ZPT, angles, THET and DELTA, and area for NPth

panel

NBODY total number of panels

XC,YC,ZC array containing coordinates of corner points of

panels

KFUSOR number of axial stations in segment

Subroutine references INLTST, INLXYZ

Called by BODPN 2

### A-31 Subroutine PANVEL

Subroutine PANVEL organizes the calls to SORPAN for the calculation of the influence of a panel at a field point. This routine computes the transformations and rotations necessary to calculate the influence of an arbitrarily oriented panel at either a field point or at the control point of another arbitrarily oriented panel. A listing of the routine is presented in Figure A-1(z) of this report.

The routine first computes . ombined transformations to rotate a panel or its image into the local panel system and back. If the same transformation is to be used for a number of calculations the logical variable, LZERO, is used to skip around this code in subsequent calls. The field point in question is rotated

into the panel coordinate system and a call made to SORPAN to compute the influence coefficient. If the body is symmetric (IXZSYM=0) the above calculations are repeated for the symmetric panel on the opposing side of the X-Z plane. The influence is summed and rotated back into the original body coordinate system.

The descriptions of the parameters in the argument list follow:

UB, VB, WB component velocity influence coefficients in body

coordinate system at field point

AN resultant normal velocity coefficient of panel at

a field point or at another arbitrarily oriented

panel

IXZSYM body X-Z plane symmetry option

Subroutine references
SORPAN

Called by

BODVEL, FLDVL2

### A-32 Subroutine PAS001

Subroutine PASOO1 performs the L\*U decomposition of the positive definite matrix, A. This routine performs no pivot search during decomposition. It does skip unnecessary calculations associated with off-diagonal zeroes. An error return is provided for encountering zero values on the diagonal. The decomposition procedure is equivalent to

The decomposed matrix is stored in the location of the original matrix. A listing of the routine is presented in Figure A-l(aa) of this report.

The descriptions of the parameters in the argument list follow:

A positive definite matrix with nonzero diagonal

elements

N actual size of matrix, A

NER diagnostic. If NER greater than zero, decomposition

failed because  $|A(NER, NER)| < 10^{-20}$ 

ND dimensioned size of A

Called by BODVEL

### A-33 Subroutine PAS002

Subroutine PAS002 solves the system of equations [L\*U] \* X = B by forward and backward substitution. It is assumed that matrix, A, has been decomposed by routine PAS001 or equivalent so that A contains [L\*U]. A listing of the routine is presented in Figure A-1(aa) of this report.

The descriptions of the parameters in the argument list follow:

A coefficient matrix containing [L\*U]

B matrix containing right-hand sides of the linear

system [L\*U] \* X = B. Contains X on output

N actual size of [L\*U] matrix contained in A

NB number of right-hand side vectors contained in

the first NB columns of B

NDA dimensioned size of A NDB dimensioned size of B

Called by

SMARCH

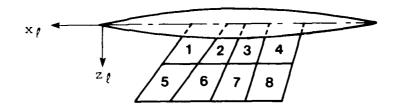
#### A-34 Subroutine PLYOUT

Subroutine PLYOUT reads in data which describe the geometric characteristics of the pylon and calculates quantities which specify the pylon constant u-velocity panels. The pylon input variables are shown in Figure 8 of Volume II. A listing of the subroutine is presented in Figure A-1(aa) and a flow chart in Figure A-9.

The first part of the subroutine reads in and prints input items 43, 44, and 45. The total number, MP, of pylon constant u-velocity panels is calculated. Next, the subroutine tests whether the pylon leading-edge and trailing-edge sweep angles are constant at all spanwise z-stations. If breaks in sweep occur, the indicator LVSPP is set equal to one; otherwise, LVSPP=0 and the quantity SLPDIF, the difference between leading-edge and trailing-edge slopes for a chordwise row, is computed outside the DO loops. The zero location of the pylon root chord is calculated, and the variables PLEX and CSIDE are initialized for laying out the first chordwise row of panels.

The remainder of the subroutine is a double DO loop within which panel leading-edge and trailing-edge slopes, corner coordinates, and control point coordinates are calculated. These quantities for the pylon are stored in arrays following the same quantities calculated by subroutine WLYOUT for the NPANLS constant u-velocity panels on the wing.

The following sketch shows the numbering convention associated with the pylon panels for a typical pylon-under-wing layout with four chordwise and two spanwise panels.



In the subroutine notation, the panel corners labeled left are those farthest from the pylon root chord.

Called by LDCALC

### A-35 Subroutine PYTHIN

Subroutine PYTHIN reads in the pylon thickness data, input items 46, 47 and 48. A listing of the subroutine is presented in Figure A-1(bb) of this report.

The number of panels in a chordwise row, NCPS, and the number of chordwise rows, MSPS, are first read in along with an index, NUNIP, which indicates whether the thickness distribution is similar at all spanwise stations. The subroutine then reads input item 47. Next, if NUNIP=1, the values of tan  $\theta_p$  are read in for the first chordwise row and then the values of tan  $\theta_p$  for the other rows are set equal to those of the first row. If the distribution is not similar, NUNIP=0, the values of tan  $\theta_p$  for all rows are read in.

Called by LDCALC

### A-36 Subroutine RACKIO

Subroutine RACKIO reads and prints the data which describe and locate the rack and calculates the rack source and doublet distributions. The rack model is limited to description as a circular body. A listing of the routine is presented in Figure A-1(cc) and a flow chart of subroutine RACKIO is presented in Figure A-10 of this report.

The subroutine first reads and prints the dimensional lengths and locations of the rack, and the polynomial coefficients which describe the shape. The rack is then located in the wing coordinate system. Both the line source and doublet distributions for the rack are calculated through a call to BDYGEN. The rack shoulder is located from the first zero slope. Lastly, the rack shock wave shape is computed in a call to SHKSHP.

Subroutine references BDYGEN, SHKSHP

Called by LDCALC

# A-37 Subroutine SHAPE

The purpose of this subroutine is to calculate the body radius and surface slope at a specified axial station. The body shape is specified by a series of polynomials of the form of Equation (1) of Volume II. A flow chart of subroutine SHAPE is presented in Figure A-11 and a listing of the subroutine in Figure A-1(cc).

The calculation performed by this subroutine consists of two steps. The first step is to determine which of the NS polynomials describes the shape at the value of X where the radius and surface

slope are required. Once this is determined, the appropriate set of coefficients is used in Equation (1) of Volume II to determine  $r/\ell$ . The value of dr/dx is found by differentiating Equation (1).

$$\frac{d\mathbf{r}}{d\mathbf{x}} = \frac{c_7}{2} \left[ \frac{2c_2 \frac{\mathbf{x}}{\ell} + c_3}{\sqrt{c_2(\frac{\mathbf{x}}{\ell})^2 + c_3 \frac{\mathbf{x}}{\ell} + c_4}} \right] + c_5 + 2c_6 \frac{\mathbf{x}}{\ell}$$
 (A-12)

It should be noted that  $r/\ell$  and dr/dx are calculated using the coefficients of the NSth polynomial if  $x/\ell$  is greater than XE(NS).

The quantities in the parameter list are:

x value of x/l at which radius and surface slope
 are to be calculated

NS number of polynomials describing body shape

XE array containing values of x/l for the end points
 of the NS polynomials

C array containing the coefficients of the NS
 polynomials

R calculated value of r/l at x/l = X

DRDX calculated value of dr/dx at x/l = X

Called by BDYGEN

#### A-38 Subroutine SHKSHP

Subroutine SHKSHP calculates the nonlinear shape of the shock wave produced by an axisymmetric body at zero angle of attack. The calculations performed here are based on the equations presented in Section 4.1.1 of Reference 3. A listing of this routine is presented in Figure A-1(dd) of this report.

The computation sequence used here is to incrementally compute the change in  $\beta$  with distance from the centerline and numerically integrate the shape radially. The procedure starts at the nose and initializes the slope of the shape to the maximum value BTNOSE prescribed through the input. A new radial distance is prescribed, and an axial search for the maximum radial velocity performed. With that velocity the local Prandtl-Meyer turning angle, local Mach number, and new shock slope,  $\beta_{\text{Vi}}$ , are computed. The new axial location of the shock shape is computed from the average  $\beta$  over the interval step

$$x_{SHK_{i}} = x_{SHK_{i-1}} + \frac{1}{2} (\beta_{v_{i}} + \beta_{v_{i-1}}) \Delta r \qquad (A-13)$$

The integration procedure is repeated until the calculated  $\beta_{\nu}$  approaches the free stream value as  $(1-\beta_{\nu\,i}/\beta_{\infty})$  < 0.01 or a maximum number of intervals of 50 is reached before terminating.

The descriptions of the parameters in the argument list follow:

NC	maximum number of axial steps used to scan for
	maximum radial velocity
SX(J)	axial station of Jth line source
SS(J)	line source strength at Jth axial station
BETA	$\sqrt{M_{\infty}^2-1}$ , value of free stream
RMAX	maximum body radius; used to determine initial
	step size, $\Delta r$
BTNOSE	limiting value of $\beta$ at nose; input
NSHK	number of values computed in shock shape table
хѕнк	array containing axial location of shock relative
	to nose
RSHK	array containing radial location of shock relative
	to centerline

Called by

FUSEIO, RACKIO, STORIO

#### A-39 Subroutine SMARCH

Subroutine SMARCH solves for the source panel strengths using a ring by ring marching technique. A listing of the subroutine is presented in Figure A-1(dd) of this report.

SMARCH is organized to solve the general source panel solution for a body in supersonic flow:

$$[A]\gamma_{B} = V_{B} - [A_{T}]_{B} \qquad (A-14)$$

where [A] is the aerodynamic influence coefficient matrix partitioned into blocks of the coefficients of one ring on another;  $\Upsilon_B$  are the panel strengths;  $V_B$  are the boundary condition normal velocities in the absence of an image body; and [A\_I] is the influence coefficient matrix of the image body on the real body control points. No image store effects will be considered in any solutions in the first program. The solution proceeds in blocks of equations, with only those blocks of equations on or below the diagonal computed and saved on TAPE9. The first block corresponding to the influence of a ring on itself is read from TAPE9 in L\*U decomposed form. The solution for that ring is computed with PAS002. Subsequent blocks in column form are read and multiplied by the strengths of that ring and subtracted from the boundary conditions for following rings.

The descriptions of the parameters in the argument list follow:

GB array of panel strengths,  $\gamma_{\mbox{\footnotesize B}}$  VB array of panel boundary conditions destroyed during solution

IA index of starting location in blank common of

temporary A matrix

IMAGE logical indicator of presence of image body

Subroutine references IOREAD, PASO02

Called by SOLVE

#### A-40 Subroutine SOLVE

Subroutine SOLVE computes the source panel boundary condition for a noncircular body in the presence of a free stream angle of attack and roll angle and calls SMARCH for the solution for the panel strengths. A listing of the routine is presented in Figure A-1 (ee) of this report.

The routine initializes the angle of attack parameters and allocates temporary storage in blank common for the arrays required during the calculation of panel strengths. The boundary conditions are defined as follows

 $V_{B} = \cos_{\alpha} \sin \delta - \cos \delta (\sin_{\alpha} \cos_{\phi} \cos \theta + \sin_{\alpha} \sin_{\phi} \sin \theta) \quad (A-15)$ 

The solution is then computed in SMARCH. A copy of blank common up through the panel strengths is then saved on TAPE7. SOLVE may be called for multiple angles of attack with each set of strengths saved sequentially after the other.

The description of the parameter in the argument list follows:

IALP index of the number of the IALPth boundary condition to be computed and saved. IALP < 7

Subroutine references
TOWRIT, SMARCH

Called by WDYBDY, STORIO

# A-41 Subroutine SORPAN

Subroutine SORPAN computes the three components of velocity induced at a specified control point by a constant source distribution on a quadrilateral panel having longitudinal taper and inclined at an angle delta to the free stream direction. This version has been specialized for only supersonic flow. This routine is based on the methods and equations presented in Reference 4. A listing of the subroutine is presented in Figure A-l(ff) of this report.

The descriptions of the parameters in the argument list follow:

UPM, VPM, WPM three orthogonal components of velocity in local panel coordinates induced by panel with control point XJ, ZJ at field point XI, YI, ZI

Called by PANVEL

# A-42 Subroutine SOURCE

Subroutine SOURCE calculates coefficients used in the determination of the line source strengths. They occur as terms in Equations (I-14) and (I-17) of Reference 1. The relation of the coefficients to perturbation velocities,  $u_{B,a}/V_{\infty}$  and  $v_{B,a}/V_{\infty}$  induced by a number of line sources distributed along the body centerline is shown in the first two of Equation (I-30) in which

the coefficients occur as the multipliers of  $K_n$ . A listing of the subroutine is presented in Figure A-1(gg) of this report. The subroutine is called by subroutine BDYGEN and Section A-4 should be referred to for further details concerning the source strength calculations.

For a specified control point,  $\mathbf{x}_{B}$ ,  $\mathbf{r}_{B}$ , and singularity origin, , the subroutine calculates quantities U and V according to the following equations:

$$U = -\cosh^{-1}\left(\frac{x_B - \xi}{\beta r_B}\right)$$

$$V = \beta \sqrt{\left(\frac{x_B - \xi}{\beta r_B}\right)}$$

At the beginning of the subroutine a test is performed to determine if the control point is ahead of the Mach cone from the source origin. If so, U and V are set to zero and control is returned to the calling program.

The definition of the variable in the argument list is:

TX

; location on body axis of source origin; positive measured from tip of nose

Called by BDYGEN

#### A-43 Subroutine STORIO

Subroutine STORIO reads and prints the data which describe and locate the multiple stores and organizes the calculation of the panel or line singularity strengths for both circular and elliptic bodies. The routine may read up to a total number of seven stores of either circular or elliptic shape. Several stores may share the data for the same shape. However, when elliptic stores are

considered, only two elliptic shapes are permitted with up to seven stores of that shape. A listing of the subroutine is presented in Figure A-1(gg) of this report. A flow chart of the routine is presented in Figure A-12.

The subroutine consists of three sequences of DO loops. The first reads and prints NSTRS cards containing the store number, shape, length, maximum radius, location relative to wing, and orientation. The second loop reads and prints NSHPT sets of shape data. If the shape is circular, items 57 through 59 of the input are read for each of the shapes. If the shape is elliptic, items 60 through 75 are read through a call to GEOM. The source panel geometry is computed and a temporary copy of all shape geometry data saved on TAPEII. The location of the store nose in the wing cordinate system is then computed for each of the stores.

The last major loop is a double DO loop over the number of shapes and over the number of stores. The outer loop is over the number of shapes to facilitate reading the panel geometry saved on TAPEll. In the inner loop on the number of stores, the store shape number is compared with the shape under consideration and the appropriate properties computed. For circular shapes, BDYGEN is called to compute the line source and doublet distributions, the shoulder location and shock shape are then calculated. For elliptic shapes, VELCMP is called to generate the influence coefficient matrix. Two calls to SOLVE may be made. For the first store of the shape the panel strengths are computed at zero degrees angle of attack and the nonlinear shock shape computed in BSHOCK. For each of the stores of that shape SOLVE is called again to compute the panel strengths at the angle of attack and roll of the fixed store. A copy of the store indices, geometry arrays, and strengths are then saved on TAPE10 by FRSTRT.

Subroutine references

BDYGEN, BSHOCK, FRSTRT, GEOM, SHKSHP, SOLVE, VELCMP

Called by LDCALC

### A-44 Subroutine SWNGIN

Subroutine SWNGIN reads in data required to describe the geometric characteristics of the wing and to lay out the wing constant u-velocity panels. A listing of the subroutine is presented in Figure A-l(ii) of this report.

The first part of the subroutine reads in and prints input items 35, 36, and 37, which consist of wing geometry data and quantities used to locate the trapezoidal-shaped elemental panels. If any nonzero dihedral angle is input, the logical variable ZDIHED is set equal to FALSE. Next, the wing twist and camber distribution, if any, is read, input items 38 and 39. Two indices, NTAC and NUNI, are first input. If NTAC=0 there is no twist and camber. The index NUNI indicates whether the twist and camber distribution is similar at all spanwise stations. If it is similar, NUNI=1, the values of tan  $\alpha_{\ell}$  are read in for the first row and then the values of tan  $\alpha_{\ell}$  for the other rows are set equal to those of the first row. If the distribution is not similar, NUNI=0, the values of tan  $\alpha_{\ell}$  for all rows are read in.

Called by LDCALC

### A-45 Subroutine THKLYT

Subroutine THKLYT calculates quantities which characterize the wing and pylon thickness source panels. These quantities are

stored in arrays in each of which the wing panel variables precede the pylon variables. All panel coordinates are expressed in the wing coordinate system which is shown in Figure 7 in Volume II. A listing of the subroutine is presented in Figure A-l(ii) and a flow chart in Figure A-l3.

The first part of the subroutine calculates the layout of the wing panels. After the variables CSIDEP, SLPDIF, ZLER, and WLEX are initialized for the first chordwise row of panels, the remaining calculations are performed within a double DO loop. The outer loop index, I, specifies the chordwise row and the inner loop index, K, the panel location in the Ith row. Within the inner loop the panel leading-edge and trailing-edge slopes, the sine and cosine of the dihedral angle, and the corner coordinates are calculated and stored. The panels are numbered consecutively in chordwise rows beginning with panel number one of row one adjacent to the wing root chord at the leading edge. The sequence proceeds in increasing numbers to the trailing edge, then back to the leading edge for the second chordwise row. The process continues until the last panel, numbered MS, is located adjacent to the wing tip at the trailing edge.

If a pylon is present (NPY=1), the remainder of the subroutine calculates the panel leading-edge and trailing-edge slopes and the corner coordinates for the pylon source panels. The procedure used differs very little from the wing panel calculations. Values of YPL, ZPL, and LVSPP, previously calculated in subroutine PLYOUT, are used. Also, the initial value of PLEX depends upon the pylon location; the index IP is tested for this purpose. The numbering convention associated with the pylon thickness panels is the same as that used for pylon constant u-velocity panels. It is described in Section A-34. In describing corner coordinates for both wing and pylon panels, the corners closer to the respective root-chords

are designated right corners; those farther from the root-chords are designated left corners.

Called by LDCALC

#### A-46 Subroutine THKOUT

Subroutine THKOUT prints the slopes of the wing and pylon thickness distributions which were read in as items 42 and 48 of the input data, see Section 3.2.2. After the thickness slopes are printed, they are divided by  $\pi$  and saved in a combined array, DZDX, for subsequent velocity calculations. A listing is presented in Figure A-1(jj) of this report.

Called by LDCALC

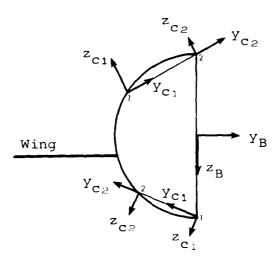
#### A-47 Subroutine VELBD1

Subroutine VELBD1 is used to obtain the single-panel uvelocity panel influence coefficients which occur indirectly in Equations (24), (25), and (26) of Reference 3. Section A-13 of this report should be consulted for further details concerning these coefficients. A listing of the subroutine is presented in Figure A-1(kk), and a flow chart in Figure A-14 of this report. The subroutine uses quantities calculated in subroutine BLYOUT which is described in Section A-5. The wing coordinate system is shown in Figure 7 in Volume II.

At the beginning of the subroutine the logical variable PYPNL is set equal to FALSE, the velocity totals UP, VP, and WP are initialized to zero, and the panel leading-edge and trailing-edge

slopes, EM, are defined as zero. In the remainder of the subroutine the influence functions for the four corners of the Ith
panel are calculated and superposed. The superposition scheme is
described in Section 3.3.4 of Reference 3 and that reference
should be consulted for further details. In the corner numbering
convention for fuselage panels corner one is the left front,
corner two the right front, corner three the left rear, and corner
four the right rear panel corner. The right corners are clockwise
from the left when viewed from the rear.

Next in the subroutine the corner influence function totals TU, TV, and TW are initialized to zero and a test is performed to determine if the point at which velocities are to be calculated lies ahead of the panel leading edge. If so, all calculations for the panel are skipped. If the point is not ahead of the leading edge, a test is performed next to determine in which fuselage quadrant the panel lies. As the flow chart indicates, two similar but distinct transformation and superposition procedures are followed, depending upon the panel location. In each procedure, the field point is first located relative to corner one in a corner coordinate system which is shown in the sketch below. Each panel corner has an associated coordinate system. The x<sub>C</sub> axis, not shown in the sketch, is positive to the rear.



If corner one is in the upper left quadrant the sign of the  $y_{C}$  coordinate of the field point is reversed and subroutine VELO1 is called to calculate the influence of the corner on the image of the point with respect to the  $x_{C}$ ,  $z_{C}$  plane. The sign of V, which is the returned influence function in the  $y_{C}$  direction, is then reversed. The functions U,V,W are resolved back into the wing system and superposed in the same manner as that used for wing panels with positive sweep (see Figure 4, Reference 1). Panels in the lower left quadrant are treated in the same manner as wing panels with negative sweep. No further coordinate change is necessary and subroutine VELO1 returns U,V, and W which are resolved into the wing system and superposed.

Next, in each procedure, the influence of the mirror image of corner one with respect to the aircraft vertical plane of symmetry is calculated. This is accomplished by the equivalent method of calculating the direct influence of corner one on the field point image. Following the call to subroutine VELO1 the sign of V is reversed in the superposition.

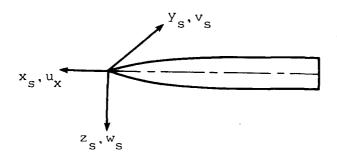
Corner one calculations are repeated in a similar manner for corners two, three, and four, but only corner one is detailed in the flow chart. After superposition of the four corner influence functions for the panel is completed, the influence coefficients for the fuselage panel at the given control point are returned by the subroutine.

Subroutine references VELO1

Called by DPCOEF

### A-48 Subroutine VELCAL

Subroutine VELCAL calculates perturbation velocities at a given field point due to the fuselage and store source and doublet distributions. A listing of the subroutine is presented in Figure A-1 (mm) of this report. The fuselage coordinate system is shown in Figure 5 in Volume II. The store coordinate system is shown in the following sketch.



The coordinates of the field point are given as formal parameters in the appropriate body coordinate system. The subroutine first transforms these coordinates into the VELCAL system by changing the sign of X and Z, and then into the polar coordinates XFIELD, RFIELD, and THETA.

The major part of the program consists of a DO loop within which the axial, radial, and tangential velocities due to the N sources and doublets are calculated and summed. A test is made to determine whether the field point is ahead of the Mach cone from the Ith source origin, TX(I). If so, all remaining perturbation velocities are equal to zero and no further calculations are performed within the loop. At the end of the subroutine, these velocities in the VELCAL system are resolved back into the body coordinate system.

The variables in the subroutine argument list are:

Т	array containing the source strengths
TC	array containing the doublet strengths
TX	array containing the x locations of the origins
	of the singularities; positive, measured oft from
	tip of nose
N	number of line sources and doublets
XP	x coordinate of field point in body system
Y	y coordinate of field point in body system
ZP	z coordinate of field point in body system
U l	u/V perturbation velocity at field point;
	body system
Vl	$ extsf{v}/ extsf{V}_{\infty}$ perturbation velocity at field point;
	body system
Wl	$ extsf{w/V}_{_{\infty}}$ perturbation velocity at field point;
	body system
BODYL	body x-station at which base singularities
	originate, feet
SUMK	strength of source originating at body base
SUMKD	strength of doublet originating at body base

Called by DPRHS

### A-49 Subroutine VELCMP

Subroutine VELCMP organizes and calls for the calculation of the aerodynamic influence coefficient matrices for the body source panels. This routine optionally reads the Mach number, angle of attack, and angle of roll. It initializes all Mach number parameters, rewinds any external files, and allocates temporary storage locations in blank common to hold blocks of influence coefficients. VELCMP performs the loop over the number of body segments calling BODVEL to compute the influence coefficients for the panels within

a segment on all other control points. A listing of this subroutine is presented in Figure A-l(nn) of this report.

The parameter in the argument list is:

IREAD option index whether to read the Mach number and angle of attack IREAD=0, read XMACH, ALPHAC, PHIR IREAD=1, no input read; parameters must be in common

Subroutine references
BODVEL, IOREAD, IOWRIT

Called by WDYBDY, STORIO

#### A-50 Subroutine VELO1

Subroutine VELO1 calculates the aerodynamic influence functions of a semi-infinite triangle associated with a constant u-velocity panel, as described in Section II-2.1 of Appendix II of Reference 1. The influence functions relate the panel singularity strength to the perturbation velocities induced by the triangle at a given point. They occur as the coefficients of  $1/\pi \left(u_+/V_\infty\right)$  in Equations (II-4) and (II-12) of Reference 1. A listing of the subroutine is presented in Figure A-1(nn), and a flow chart in Figure A-15 of this report. The coordinate system used by the subroutine is shown in Figure 3 of Reference 1.

At the beginning of the subroutine the logical variable FELT is initialized to TRUE and a test is performed to determine if the field point is located ahead of the influencing triangle (X < 0).

If so, the influence functions U,V,W are set to zero, FELT is set to FALSE, and control is returned to the calling program.

Next, the variable PYPNL is tested and, if the triangle is on the pylon, a transformation is performed which rotates the triangle into the VELO1 x,y plane. After the calculation of the logical variable INSIDE and other frequently used quantities, the remainder of the subroutine consists of four major sections in which the influence function terms, F1, F2, F4, F5, and F7, are calculated. Each section corresponds to a condition of the slope, EML, of the leading edge associated with the semi-infinite triangle. The subroutine requires that EML  $\geq$  0 and this is accounted for in the VELO1 calling programs. The four leading-edge conditions are described fully, with accompanying sketches in Section II-2.1 of Reference 1. All equation numbers mentioned in the following paragraphs are from Section II-2.1 of Reference 1.

The first section of the subroutine corresponds to a subsonic leading edge, BTSQ < EMLSQ. Equation (II-5) is used if the point is inside the Mach cone from the origin, INSIDE=TRUE. If not, U,V, and W are set to zero. In this section as in the remaining ones, discontinuities in some of the equations may occur for certain field point locations. In such cases the affected influence function is set to zero. The quantities YYEDGE and TLRNC, as well as Y and Z, are used to test the singularity locations.

If BTSQ=EMLSQ, the leading edge is a sonic leading edge. The equations used are the same as for the subsonic case except for the function F2, which is given by Equation (II-7). If the point lies outside the Mach cone from the origin, the influence functions equal zero.

The third section of the subroutine is used if the triangle leading edge is supersonic, BTSQ > EMLSQ. Equations (II-5) and (II-9) calculate the terms of the influence functions if INSIDE= TRUE. If not, a second test is performed and Equation (II-11) is used if the point is inside the Mach cone whose origin is on the leading edge at the field point y location, otherwise the functions U,V,W are set to zero.

The fourth section of the subroutine is executed if the leading edge is unswept, EML=0. For this special case the perturbation velocity equations are given by (II-12). If INSIDE=TRUE, the influence function terms are given by (II-5) and (II-13). Outside the Mach cone from the origin but inside the cone from the leading edge Equation (II-14) is used, otherwise, U,V,W are set to zero.

The last part of the subroutine calculates the functions U,V, W from the component terms, in the case of a leading edge with positive sweep, using Equation (II-4). If the triangle is located on the pylon, V and W are rotated back into the pylon u-velocity panel coordinate system.

Called by

VELBD1, VELPP1, VELWP1

### A-51 Subroutine VELOT1

Subroutine VELOT1 calculates the aerodynamic influte a functions of a semi-infinite triangle associated with wing r pylon thickness panel, as described in Section II-2.2 of Appendix II of Reference 1. The influence functions relate the panel source strength to the perturbation velocities induced by the triangle at a given point. They occur as the coefficients of  $1/\pi(\tan\theta)$  in Equations (II-15) and (II-16) of Reference 1. A listing of the subroutine is presented in Figure A-1(pp) of this report. The

subroutine is very similar in logic to subroutine VELO1 which is described in detail in Section A-50 and represented by a flow chart in Figure A-15.

In subroutine VELOT1, three component terms, F1, F2, and F5, need to be calculated in order to determine the influence functions UTH, VTH, and WTH. Referring to Sections II-2.1 and II-2.2 of Reference 1, function F1, F2, and F5 are specified in Equation (II-5) for the case of a subsonic leading edge, in Equations (II-5) and (II-7) for a sonic leading edge, and in Equations (II-5), (II-9), and (II-11) for a supersonic leading edge. For the special case of an unswept leading edge (EML=0), the general perturbation velocity equations are given by (II-16). given point lies inside the Mach cone from the origin of the triangle, function Fl is given by Equation (II-13), function F5 by Equation (II-5), and function F2 by Equation (II-17). If the point lies outside the Mach cone from the origin but inside the Mach cone from the triangle leading edge at the field point y location, functions Fl, F2, and F5 are given by Equation (II-16). In all leading edge cases, the function Fl, F2, and F5 are singular for certain field point locations. When this occurs, the affected influence function is let to zero. All influence functions are set equal to zero if the point lies in the plane of the semi-infinite triangle (ZTH=0).

A table equating the algebraic and program notation for variables in common for subroutine VELOT1 is presented in Appendix B-2 of this report. Almost all of the notation used in subroutine VELOT1 is defined in this table. One should note that the influence functions, U,V,W and the point coordinates, YS, ZS, in VELO1 are named UTH, VTH, WTH, YTH, and ZTH, respectively, in subroutine VELOT1.

Called by VELOT1, VELPT1

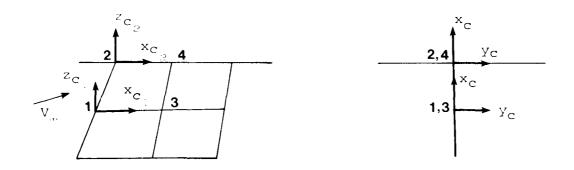
#### A-5\_ Subroutine VELPP1

Subroutine VELPP1 calculates the single panel infruence coefficients which form the coefficients of  $1/\pi (u_+/v_c)$  in Equation (12) of Reference 1. A listing of the subroutine is presented in Figure A-1(qq) and a flow chart in Figure A-16. The quantities XX, YY, ZZ in the subroutine argument list are the x,y,z coordinates in the wing coordinate system. The wing coordinate system is shown in Figure 7 of Volume II.

At the beginning of the subroutine, the logical variable PYPNL is set equal to TRUE, indicating to subroutine VELO1 that calculations are to be performed for a pylon panel. The quantities YDIR and YIMG are calculated and the velocity totals, UP, VP, WP, are initialized to zero. In the remainder of the subroutine the influence functions for the four corners of the panel are calculated and superposed. The superposition scheme is described in Section 3.3.4 of Reference 3 and that reference should be consulted for further details. The corner numbering convention for pylon panels associates corners one and two with the leading edge left and right corners, respectively; corners three and four with the trailing edge left and right corners, respectively. The left corners are those farther from the pylon root chord.

At the beginning of the calculation the influence function totals are initialized to zero and the leading-edge slope, EMl, and trailing-edge slope, EM2, are defined. Next, a test of the sign of EMl is performed and two distinct transformation and super-position procedures are followed depending on the results of this test, as the flow chart indicates. In each procedure a test is

performed first to determine if the field point lies ahead of the most forward leading-edge corner; if so, all calculations for the Ith panel are skipped. If the point is not ahead of the leading edge, the point is located relative to corner one in a corner coordinate system which is illustrated in the sketch below. Each panel corner has an associated coordinate system.



For a panel with swept back leading edge, EM1  $\geq$  0 the superposition scheme is the same as for a wing panel with positive sweep (see Figure 4, Reference 1). The field point z coordinate is reversed and subroutine VELO1 is called to calculate the influence of corner one on the image of the point with respect to the x ,y plane. The sign of W is then reversed. The functions U,V,W are resolved back into the wing system and superposed. If the panel leading edge is swept forward, superposition is the same as for wing panels with negative sweep. The sign of EM1 is reversed and subroutine VELO1 returns U,V,W which are resolved into the wing system and superposed. It should be noted that the subroutine code combines superposition and transformation steps and that the final sign changes of U and W are made at the end.

The next calculations are omitted if the pylon is located under the fuselage centerline. Otherwise, the influence of the mirror image of corner one with respect to the vertical plane of symmetry is calculated. This is accomplished by the equivalent method of calculating the direct influence of corner one on the amage of the field point and then reversing the clan of V.

Corner one calculations are repeated in a whall a manner of corners two, three, and four, but only corner one in discriming detail in the flow chart. After superposition of the rear corner influence functions for the panel is completed the interested point coefficients for the Ith pylon panel and the river control point are returned by the subroutine.

Subroutine references VELO1

Called by DPCOEF

# A-53 Subroutine VELPTL

Subroutine VELPT1 calculates perturbation velocities at a field point due to the pylon thickness distribution according to methom described in Section 3.3 of Reference 4. This crigian logic is very similar to that of subroutine VELPP1 which calculates value ities induced by the pylon constant u-velocity panels. Subroutine VELPP1 has been described in detail in Section A-52 and is represented by a flow chart in Figure A-16 of this report. Only those details, therefore, in which subroutine VELPT1 differs from subroutine VELPP1 are included in this description. A listing of the subroutine is presented in Figure A-1(ss). The quantities in the subroutine argument list are the x,y,z coordinates of the field point in the wing coordinate system.

The coordinates of the field point are given as formal parameters in the wing coordinate system. The point is located relative to each of the four panel corners using the same transformation scheme as in VELPP1. However, the corner coordinate arrays which define the pylon thickness panels and which have been previously calculated by subroutine THKLYT (see Section A-45) are used in the transformations. Subroutine VELOT1 is called to calculate the corner influence functions, U,V,W, which are then superposed in the same manner as in VELPP1.

The subroutine calculates perturbation velocities only. The influence coefficients are multiplied by DZDX(I) to obtain perturbation velocities induced by the Ith panel at the given point. These velocities are calculated and summed for all pylon thickness panels.

Subroutine references VELOT1

Called by DPRHS

# A-54 Subroutine VELWP1

Subroutine VELWP1 calculates the influence coefficients at a specified control point due to a wing constant u-velocity panel. The influence coefficients occur in Equation (27) of Reference 3 as the coefficients of  $-/\pi$ )  $(u_+/V_\infty)$ . A listing of the subroutine is presented in Figure A-l(tt), and a flow chart in Figure A-17. The quantities in the subroutine argument list are the x,y,z coordinates of the field point in the wing coordinate system. The wing coordinate system is shown in Figure 7 of Volume II.

At the beginning of the subroutine, the logical variable PYPNL is set equal to FALSE indicating to subroutine VELO1 that calculations are for a wing rather than a pylon panel. The influence function totals, TU, TV, TW, are initialized to zero. The leading edge slope, EM1, and the trailing edge slope, EM2, as well as the dihedral angle sine and cosine, are defined. The remainder of the subroutine consists of the calculation and superposition of the influence functions for the four corners of the influencing panel. The superposition scheme is described in Section 3.3.4 of Reference 1 and that reference should be consulted for further details. The corner numbering convention for wing panels is shown in Figure 4 of Reference 1.

Two distinct transformation and superposition procedures are followed depending on the sign of EMI, for corners one and two, and EM2, for corners three and four. In each procedure the point is first located relative to corner one in the coordinate system associated with subroutine VELO1, illustrated in Figures 3 and 4 of Reference 1. Dihedral effects, if nonzero, are included in the coordinate transformations. Subroutine VELO1 is called to calculate the corner influence functions, U,V,W, which are resolved back into the wing system and superposed. Superposition and transformation steps are combined in the code and the final sign changes of U and W are made at the end of the subroutine. Next, in each procedure, the influence of the image of corner one with respect to the aircraft vertical plane of symmetry is calculated. This is accomplished if EM1 < 0 by the equivalent method of calculating the direct influence of corner one on the field point image and then reversing the sign of V.

Corner one calculations are repeated in a similar manner for corners two, three, and four, but only corner one is detailed in the flow chart.

Subroutine references VELO1

Called by DPCOEF

# A-55 Subroutine VELWT1

Subroutine VELWT1 calculates perturbation velocities at a given field point due to the wing thickness distribution, according to methods described in Section 3.3 of Reference 3. The program logic is very similar to that of subroutine VELWP1, which calculates influence functions for the wing constant u-velocity panels. Subroutine VELWP1 has been described in detail in Section A-54 and is represented by a flow chart in Figure A-17 of this report. Only those details, therefore, in which subroutine VELWT1 differs from subroutine VELWP1 are included in this description. A listing of the subroutine is presented in Figure A-1(ww). The quantities in the subroutine argument list are the x,y,z coordinates of the field point in the wing coordinate system.

The coordinates of the field point are given as formal parameters in the wing coordinate system. The point is located relative to each of the four corners of the trapezoidal shaped thickness panels using the same transformation schemes as in VELWPl. However, the corner coordinate arrays which define the wing thickness panels and which have been previously calculated by subroutine THKLYT (see Section A-45) are used in the transformations. Subroutine VELOT1 is called to calculate the corner influence functions, U,V,W, which are then superposed in the same manner as in VELWP1.

Finally, the subroutine calculates perturbation velocities rather than single panel influence coefficients. Thus, after

the calculation of the influence coefficients for the Ith panel is completed, the influence coefficients are multiplied by DZDX(I) to obtain the perturbation velocities induced by the Ith panel at the given field point. These velocities are calculated and summed for all wing thickness panels.

Subroutine references VELOT1

Called by DPRHS

### A-56 Subroutine WDYBDY

Subroutine WDYBDY reads and prints the noncircular fuselage data and organizes the calling sequence for the body panel layout, the computation of the source strengths, and the generation of the nonlinear shock shape. A listing of the routine is presented in Figure A-1(zz) of this report.

WDYBDY is used to generate the required solutions for the noncircular fuselage. It first reads and prints the basic length, width, nose shock angle, and interference shell length and number of panels. The noncircular fuselage geometry is read and panels laid out in a call to GEOM. The panel cross section data to be used for the fuselage interference shell is saved by YZBIP. The influence coefficient matrices and the solution for the shock strength are generated in calls to VEICMP and SOLVE. The nonlinear shock shape is generated in a call to BSHOCK and all data to be passed to Program II saved on TAPE10 by FRSTRT.

Subroutine references

BSHOCK, FRSTRT, GEOM, INLSHK, SOLVE, VELCMP, YZBIP

Called by LDCALC

# A-57 Subroutine WITHIN

Subroutine WITHIN reads in the wing thickness data, input items 40, 41 and 42. A listing of the subroutine is presented in Figure A-1(aaa) of this report.

The number of panels in a chordwise row, NCWS, and the number of chordwise rows, MSWS, are first read in along with an index, NUNIS, which indicates whether the thickness distribution is similar at all spanwise stations. The subroutine then reads input item 41. Next, if NUNIS=1, the values of tan  $\theta$  are read in for the first chordwise row of panels and then the values of tan  $\theta$  for the other rows are set equal to those of the first row. If the thickness distribution is not similar, NUNIP=0, the values of tan  $\theta$  for all rows are read in.

After the thickness slopes are read in, an input error check is performed. If any of the tan  $\theta$  values is zero or negative at the wing leading edge, an error message is printed (see Section 3.5, Volume II) and the program halts.

Called by LCALC

### A-58 Subroutine WLYOUT

Subroutine WLYOUT calculates quantities which characterize the constant u-velocity panels on the wing. An example of a wing trapezoidal panel is shown in Figure 2 of Reference 1.

Similar routines PLYOUT and BLYOUT calculate these quantities for the pylon and fuselage panels, respectively. The arrangement

of variables in any single coordinate array is wing panels first, pylon panels second, and fuselage panels last. All coordinates are in the wing coordinate system which is shown in Figure 7 of Volume II. A listing of the subroutine is presented in Figure A-1(aaa), and a flow chart in Figure A-18 of this report.

As indicated by the flow chart, the first part of the subroutine tests whether the wing leading-edge and trailing-edge
sweep angles are constant at all spanwise Y-stations. If
breaks in sweep occur, the indicator LVSWP is set equal to one;
otherwise, LVSWP=0 and the quantity SLPDIF, the difference
between leading-edge and trailing-edge slopes for a chordwise
row, is computed outside the main DO loop.

After initializing the quantities CSIDEP, ZLER, and WLEX, the remainder of the subroutine consists of a double DO loop. The outer loop index, I, controls the chordwise row; the inner loop index, K, specifies the panel location in the Ith row. Within the inner loop, the leading-edge and trailing-edge slopes, the sine and cosine of the dihedral angle, the corner coordinates, and the control point coordinates are calculated and stored for each panel. The convention used in numbering the NPANLS wing constant u-velocity panels is the same as that used for the wing thickness panels. Section A-45 should be referred to for details. In the subroutine notation, the right-hand side of the panel is the one closer to the root-chord.

Called by LDCALC

### A-59 Subroutine WRFILE

Subroutine WRFILE writes the data set on TAPE12 which contains all the information required to continue the supersonic store

separation computations in Program II. A listing of the routine is presented in Figure A-1(bbb) of this report.

WRFILE writes all the data required for Program II unformatted on TAPE12. The data includes the list of headings, control indices, various constants, u-velocity data, thickness panel data, fuselage geometry and strength data, rack data, pylon data, and data for multiple stores. When saving information required for the noncircular fuselage or elliptic stores, the appropriate arrays are transferred from TAPE10 to TAPE12 using routine FRSTRT.

Subsoutine references
FRSTRT

Called by LDCALC

### A-60 Subroutine YZBIP

Subroutine YZBIP is used to organize the scan of the source panel geometry to define the cross section data for the non-circular fuselage interference shell. YZBIP performs the loop over the number of body segments in organizing the data for a scan of the axial geometry. The scan of panel geometries within a segment are performed in a call to YZBIP2. A listing of this subroutine is presented in Figure A-1(ccc) of this report.

Subroutine references YZBIP

Jalled by WDYBDY

# A-61 Subroutine YZBIP2

Subroutine YZBIP2 scans the source panel geometry of a single body segment and performs the interpolation in the data to define the y-z values of the section to be used by BLYOT2 to define the body interference shell. The routine scans the arrays of axial stations to find the two sections which bound the input station, XBIP (item 15). A linear interpolation between the Y-Z values of the two sections is then performed. This table of Y-Z values is used by BYLOT2 to specify the Y-Z values of the fuselage interference shell as close to the source panel geometry as possible. A listing of this routine is presented in Figure A-1(ccc) of this report.

The descriptions of the parameters in the argument list follow:

XB array of axial stations of section data of

segment

YB, ZB arrays of Y-Z coordinates of panel corners

KRAD number of corners in the polar direction about

the body

NFUSOR number of axial stations in segment

Called by YZBIP

Figure A-1.- Listing of Program I
(Pages 84 through 138)

PHOGRAM LDCALCTIMPUT.OUTPUT.1APES=IMPUT.TAPE6=OUTPUT.TAPE12 LCCA 10	ZZINAROCHINCIDENCE ANGLE DI WING HOUT CHUNC HELMINKE TO FUSELADE MALDOR 2357258 MANIM REFERENCE HOEGHESI	CA 750
TPC T	TAU FURNATIIMI.451. 43HU-VELCCITY FAMEL CONTROL POINT COOKDINATES./ LDCA	311 43
	I stranghillerfetiach attochlits incoted all impat Points./ LDCA 2 astrasmintolliaist and camete stoke at IMESE Points./ LCCA	38.C ¥3
04 4001	A NAMES AND CONTRACT SINGULARITY STRENGINGS A NAMES AND CONTRACT SINGULARITY STRENGINGS TO CONTRACT STRENGINGS TO	900
	741 + (HHATI/10A.19HEING CONTFOL POINTS/17A.3NKOE.2A.5HPENEL.5A.5HA. FTLDC	CA 820
1415 PROGRAM LAYS OUT THE PANELS REPRESENTING THE PARENT ATRICARTILLEGA 90	1.65.541. FT.6X.5HZ. FT.6X.6HU/VINF.5X.6HV/VINF.5X.6HW/VINF.5X LOCA	0 4 8 3 C
U VELOCITY PAMEL STRENGTHS.	2 FURWATC154-215-34-8F11-5)	
LOCA 120	AS FORWATIC/10%, 20%-YLUN CONTROL POINTS/17%, SMROW, 2X, 5MPANEL, 5%, 5MX, FL	
ALL GUNNITIES HEAD IN 61 1415 PROUNTE OF CALCULATED OF 1715 LOCA 150 PROGRAM WAILE APERE REQUIRED BY THE TRAJECTORY PROGRAM, LOCA 140 7		089
PROGRAM 2. ARE WRITTEN OUT ON TAPE 12.	45 FORMATIVIDA. 23HFUSELAGE CONTROL POINTS/16A. APPRING. 2A. SHPANEL. SA.	068 V
THE TOA PECTODY CALCULATION PROGRAM READS THIS DATA SET IN. LOCA 220	ISEK, FI-GK-SEK, FI-GK-SEZ, FI-IZR-SEK/VINF-SK-SEZ-SEZ-Z-SEK.	000
000 PDC	LECTRON CONTROL OF 11.5 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
LOGICAL CENTER	754 FORMATIL///SA-20H**** NSTPS INPUT AS-13-33H. PROGRAM LIMITED TO SELDCA	
DIMENSION STATEMENTS LDCA 210 C	145.4 310453	050 A3
LDCA 220	PI=3,141592653	
COMENSION REDUCED TO A STATE OF THE STATE OF	710s1.570746327 010bs0.0174530025	
COMMON STATEMENTS	RT00=57_29577951	
	F0U9PI=12.56637062	000147
1 SANGE		CA1020
COMMON /CAMBER/ ALPHAL(200)	READ (5.701) NCARDS	CA1630
COMMON / CONTIGO METAPA-MANTAS-LEVANDARCA COMMON / CONTIGO METAPA MANTAS CONTIGO METAPA MANTAS CONTIGO METAPA MANTAS CONTIGO M	REWIND 12	CA1040
COMBON VERMEN V REPERTURE (DOUGH TOWN VERMEN	EXTIL (IL) ALEXDS	3000
COMMON VELOW / ALFACTOR GAME FEMACHANING BETACOUNTS FOR MICHES TO THE COMMON VELOW / ALFACTOR GAME FEMACHANDON VING BETACOUFFECTOR DE COMMON VELOW / ALFACTOR GAME FEMACHANDON VING BETACOUFFE COMMON VING BET	00 10 JE1-WCARDS	CA1070
COMMON /FSGEOM/ FRMAK-SSPAN, FLTMC-BODYPL	READ (5, 703) HEAD	CA1080
COMMON / ICVEL / UP.VP.WP.111.1F. GELTP(200)	WRITE (12) MEAD	CA1090
COMMON VINCEN / NGARMARANDENDENDENDENDENDORNINGOUNDOUNGIVERDENDOCA NO 100 110 110 110 110 110 110 110 110 11	10 MP17E (6-706) MED	001140
COMMON VPTGFOM Z 2201-xPLF-1PL CRP-MP-PSIPLE (20)-PSIPTE (20)-IP- LDCA 380-		CA1120
\$ SLLE-PSLPOF-CENTER-ZPL-LVSPP	SPECIFY FLIGHT CONDITIONS	041130
COMMON /RKGEOM/ PRIMAX.ALTHC.XMROC.YMRO.ZMRO.MRPOLY.RKEND(7). LDCA 400 C		LDCA1140
MODER (1.1.) ANDO MENDO MENDO MENDE MENDO MEND	READ (5:706) ALFAC.FMACH	LDCA1150
CONTROL VARIORIA VARIORIA SERVICA CONTROL VARIORIA VARIOR		LDC#1150
1 NSPOLY(7).5XEND(7.7).5COEF (7.7.7).XBSO(7).YBSO(7).ZBSO(7). LDCA ++C	BETASO=FMCHSO=1.0	LDC#1180
SIBGH(1), NUMSTR(7), SSIBGR(7), CSIBGR(7), SPHIRR(7), NSMAPE(7)	BETAD=SQRT (BETASQ)	LDCA1190
3 •NSMPT-WEIRPE(1)   LOCA 460   COMMON WIND   LOCA 460   COMMON WIND   C	ALFACR=ALFAC+DTOR LDCA1	CA1200
COMMAND   VINCENT   VINC	SPECIET AIRCRAFT COMPONENTS TO BE INCLUDED	CA1220
2 THETAL (400) - THETAL (200) - SLLET (400) - SLTET (400) - DZDX (400) - LDCA 490 C		CA1230
3 YS(201.PSWSLE (201.PSWSTE (20).PMIS(20).ZS(20).PSPSLE(20). LOCA 500	READ (5-701) NFU-NPY-NRACK-NSTRS	CA1240
A POSESTE (COLS. SAMPLES (400) - CSPPHS (400) - CSP	IF (NSTRS.LT.8) 60 10 2	041250
COMMON / WEEGON / MBMOG. ZBHO. CRASSEPARES. SEPARES. SEPARES (20).	\$10b	CA1270
I PSIMTE (20), VIZO), PMID(20), ZDIMED, MICR		CA1280
COMMON YENGEDON XRT (200) XRTB(200) XRTR (200) XRTR (20	INPUT FUSELAGE DATA IF FUSELAGE IS PRESENT	067140
2 SNPMI(200).4XPI(200).4XPI(200)	2 NBIP=0	CA1310
COMMON A(40200) LDCA 500 C	NFU=1. CIRCULAR BODY OPTION USING LINE SOURCES	CA1320
EQUIVALENCE (FVN(1,1).A(1))	MFU=2, USE GENERAL SOUNCE PANELING METHOD FOR BODY	LDCA1330
FORMAT STATEMENTS	IF (NFU.EQ.2) CALL WOYBOY	LDC41350
1004 620 C		LDCA1360
70] FORMATION: SANCE LEGISTER CONTROL OF TABLE SETTING TRANSCORE AND TRA	INPUT MING DATA	LDCA1370
DEPT TOTAL CONTRACT C	READIS. 7061 XBWOC. ZBWO. WIC	CA1390
rpc		CA1400
704 FORMAT(100K-20A4)	MRITE(6+713) XBWOC+ZBWO-WIC	CA1410
		CA1430
AIRCRAFT FLIGHT CONDITIONS/15X+17HANGLE OF ATTACK #+LDCA	SAICH = SIN(WICH)	CA1440
1F6.2-01 OCGRES/15X-13-13-14-01-01-01-01-01-01-01-01-01-01-01-01-01-	CALE SWAGIN	CA1450
	1FANCE (1104-15E-5) 2	000147

555 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	LAY 001 CONSTANT OFFECTIVE PARELS OF THE	LDC 41 4 90		CALL DPCOEF
I	CALL MCYOUT	LDCA1510		FVX:[.APTOTD.#CIR.I]
CALL   MICHAELS DATA   CORTISSON   CORTI		250		
CALL   INVERTING   CALL   INVE		5 0 0	. u	SOLVE LINEAR STSTEM
IMPOUT PROOF LAYOUT IMPORANTION IF PRICON IS PRESENT   IDEALISED   COLLING	CALL MITHIN	929	U	
DECEMBER	INFORMATION IF	LDCA1570		
CHANGE   CONTINUED   CONTINU		LDCAISBO	-	
CALL   PARTY   CONTROL	0.00	0 0		
CALL PAYING   IMPOINT STORY   CONTROL   CALL PAYING   IMPOINT STORY   CONTROL   CALL PAYING   IMPOINT STORY   CONTROL	74 .EQ. 01 GO TO	1610	U	
CALL PATCH		950	<b>.</b> .	
Law Out   Price   Price   Locales	CENTERNAL SEES 0.0	2 0	ں,	
COLT PATH HE CONTRACTS  CONTRACT  CO	IMPUT PYLON THICKNESS DATA	650	<i>.</i> .	0 0 0 2 1
CART   CONTINUE   CO	CALL PYTHIN	0.0	. ر	
### ### ### ### ### ### ### ### ### ##		LDCA1680		
CALL THICKNESS DISTRIBUTION  CALL THROUT  LAY OUT THICKNESS PAMELS ON WING AND PYLON IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE  LAY OUT CONSTANT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE  LAY OUT CONSTANT  LOCATION  LOCAT	Mind and the S	LDCA1690		20 100 121 20 2X
CALL THEOLY  LAT OUT THICKNESS PANELS ON WING AND PYLON IF PRESENT  LAT OUT THICKNESS PANELS ON WING AND PYLON IF PRESENT  LAT OUT THICKNESS PANELS ON WING AND PYLON IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAG	QUIPUT THICKNESS DISTRIBUTION	LDCA1710		
CALL THROW!  Lav Out THICKNESS PARELS ON WING AND PYLON IF PRESENT  Lav Out THICKNESS PARELS ON WING AND PYLON IF PRESENT  Lav Out CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  Lav Out CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  Lav Out CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  Lav Out CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  Lav Out CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  Lav Out CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT  Lav Out CONSTANT  Lav		LDCA1720		NAME OF THE CONTRACT OF THE CO
LAT OUT THICKNESS PANELS ON WING AND PYLON IF PRESENT LUCATION CALL THALT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT LUCATION CALL THALTT  LAY OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT LUCATION CALL MAY AND	CALL THROUT	LDCA1740	300	
LAY OUT COMSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT LOCA1700 LOCA1800	ON MING AND PYLON IF	150		
LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT LOCAITOR (CALLING)  LAT OUT CONSTANT U-VELOCITY PANELS ON FUSELAGE IF PRESENT LOCAISON (CALLING)  NAPPARAMS.**		200	ں ر	PYLON PANELS
LOCATE ONSIANI U-VELOCITY PANELS ON FUSELAGE IF PRESENT LOCATION  NIPPRARMS SHI		780	u	
NIP = MP = MP = MP	U-VELOCITY PANELS ON FUSELAGE IF	LDCA1790		2
	NIPampam, S+1	LDCA1810		20. 101 00 00 00 00 00 00 00 00 00 00 00 00
	N2HWPAMLS+MP	LDCA1820		NAOME (J-NPANES-1) /NCP+1
	MADENDE I	LDCA1830		ZZPZBL-ZZPBZ(J-ZZPBZ)
NET	# (MFU.E4.1) CALL BLYOU!	1920		
	MPTOT = N.2 - N.B.1.P	860	o u	FUSFLAGE PANELS
I   I   I   I   I   I   I   I   I   I		980		
If impack.fo.00 GO TO 215	INPUT RACK DATA IF PRESENT	LDCA1890	=	IF (MrU.E0.0) 60 TO
COLD   COCA	09 (0.0	LDCA1910		00 102 JEN2P.NPTOT
LOCATE MACK IN FUSELAGE COORDINATE SYSTEM LECTION LOCATION COORDINATE SYSTEM LECTION COORDINATE SYSTEM LECTION COORDINATE SYSTEM LECTION COORDINATE COORDI		LDCA1920		MADURA (J-M2+1) / MBD+1
CONTINUE		LDCA1940		27127 = 0.127 = 0.04   1.27
SAGE		LOCA1950	201	
Manual Control	Spiece Six (RibCe)	LDCA1960	,	
DECA1999 C CALL ROUTINE   DECA2900 C CALL ROUTINE	MODOS MARCOL - MARCOL - CAICA - SANO - SAICA			
LOCAZONO C	YBROHYERO		, ں	f Oa
IDGA22220   CALL NULTY   IDGA22220   CALL NULTY   IDAA22220   CALL NULTY   IDAA22220   CALL NULTY   IDAA22220   CALL NULTY   IDAA22220   CALL NULTY   IDAA2220   CALL NULTY	ZBROmzawo -xarbocesalchez Continus		ں د	TRACECTORY PROGRAM
IMPUT STORE DATA IF PRESENT   LOCAZOGO C CALL ROUTINE				CALL MULYT
F (MSTRS .EG. 0) 60 TO 30	INPUT STORE DATA IF PRESENT			ROUTINE
LOCAZONO CALL WAFFLE	0 60 10	LDCA2050		
LOCATE STORE   PUSELAGE COORDINATE SYSTEM   LOCATED	CALL STORTO	LOCA2060		
LOCA2200	FUSELAGE	LOCA2080		ENO
\$\text{SIGNER}\$\		LDCA2090		
CSTREENTY-COSTSTACE   COMPANY   CSTREENTY-COSTSTACE   COMPANY   CSTREENTY-COSTSTACE   CSTREENTY-CSTREE	OO 35 MWILMSIPS \$SIBCP(N)#SIM(SIPCR(N))	LDCA2110		
1950(H) 17450(H) 1950(H) 1950(		LDCA2120		SUBROUTINE ASECTN (Y.Z.NRAD.AREA)
28501H) ZBBO -XBSC(N) *SBICR-ZBSC(N) *CBICR  COMETING  LOCAZIDO T MOUTE COUNTE CROSS SECTIONAL AREA ENCLOSEU RY  LOCAZIDO C TOMENSION Y FROM DIGHT MAND SIDE OF CONSTANT  LOCAZIDO COMPON Y FROM DIGHT MAND SIDE OF CONSTANT  LOCAZIDO COMPON Y FROM DIGHT MAND SIDE OF CONSTANT  LOCAZIDO COMPON Y DIGHT MAND SIDE OF CONSTANT  LOCAZIO COMPON Y DIGHT MAND SIDE OF CONSTANT  LOCAZIO COMPON Y FROM DIGHT MAND SIDE OF CONSTANT  LOCAZIO COMPON Y DIGHT MAND SIDE OF CONSTANT  LOCAZIO COMPON Y DIGHT MAND SIDE OF CONSTANT  LOCAZIO COMPON Y SHORT SIDE OF CONSTANT  LOCAZIO COMPON Y SHORT SIDE OF CONSTANT  LOCAZIO COMPON Y SHORT SHO	7850(N) #7#50(N)			
FFICIFUT MATRIX AND PIGHT WAND SIDE OF CONSTANT COCKEIND OCITY EDUATION. APPRANCE IN FUN APPRAY IN AUGMENTED LOCKZIOO X FORM.	; 2650in) #2840 -*#50Cin) *S#ICR+2#50in) *C#ICR ; continué			TO COMPUTE CRUSS SECTIONAL AREA ENCLOSEU BY SHAPE.
DCITY EQUATION. ARRANGE IN EVM ARRAY IN AUGMENTED LDCA2190 X FOBW. LDCA2200 LDCA210	UP COEFFICIENT MATRIX		,	DIMENSION YINGADI. 2 (NGAD)
LDCA2210	U-VELOCITY COURTION.	LDCA2190		COMMON 701MENS/ DIM(130) EQUIVALENCE (DIM(131,1125YM)
		LDCA2210		0.0 = 4304

Figure A-1(c)

יייני ביייני	•	בר בר בר בר
	-	9
ELD = XF (	80VG1+30 1 YLC(2001-xCHT(2001-XCHT(2031-XCHT(2001-SWHHE (2001-SWHHE (2001-SWHE (2001-	. 61.10
MF [ELD = MF (1)	~	BLTO
\$L006.2080 (1)	BOVELAKO C DATA FACO OK.	97 02 78
CALL SOURCE (TR(J))	U	84.019
205 A(J) ** - \$LOPE *U		BL 10 19
*D##107	BOYELSON C COUNDINAILS TO MING COUNDINAIL STSIEM.	84.70 21
00 501 J=1.1*]		BL 70 22
201 Schmidt (U) *** (U		9L 70 23
Townson to the contract of the	BOYGISAD C LAY OUT FUSELAGE CONSTANT U-VELOCITY PAHELS	8LY0 250
	J	BL10 26
DETERMINATION OF BOUGLET STRENGTHS AT CONTROL POINTS MIDMAN RETHERM BOOK DEFINITION POINTS	80761540	BL 10 27
		BLY0 29
CALCULATION OF THE FIRST DOUBLET STRENGTH.		BLYO 30
	CONTRACTOR OF THE PROPERTY OF	E 0.79
45 (ECONT) (1)	IF (ABS (ANGM-P12) .LE 3017) GO TO	84.10 33 84.10 33
SLOPE = DADA (1)		86.70 34
CALL DOUBLISTK(1))	، ن	BL 70 35
# CLOPE SCOPE # CLOPE	BUTGEORG C WING IS NOT TANCENT IN FUSELAGE	BL 70 36
	,	86.40.38
CALCULATION OF THE REST OF THE DOUBLET STRENGTHS	BDY61680 IU=M8DCR2	BL VO 39
		8CT0 40
N-2a1 ST2 00		1 0 4 0 4 0 4 0 4 0 4 0 4 0 4 0 4 0 4 0
AF IELD=RF (1)	_	Bryo
SLOPE =040x (1)		BL 70 ++
1.1=0 215 00	210	8LY0 +5
CALL DOUBLI (TA(U))		BLY0 +60
Š	8D76177 00 260 1=1L-1U	0, 76
[+]=[-]		BL 70 .90
IMI*(mf E02 00		8LY0 50
	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	81.40.51
TC:Nx8007) *0.		PL 10 53
		BL 70 54
PRINT OUT OF BODY CHAPACTERISTICS	BUYELBAO CSS-FICOS(AND) BUYELBAO OO SKK (-1. MBT) NOO	81.40 55
WASTE (6.701)		8C 10 28
00 000 1#1.WXR00Y		BL 10 58
	80761880	65 0 7 18 61 40 59
7014013114		BLY0 610
CALCULATE SUM OF TIJ) AND TCIJ)	u	8LT0 62
SUMM(#0.0	BOY61930 2CPT(K) # ZwING(CPY)	F 70 52
SUMMO = 00		BL 10 65
30 30 00 00 00 00 00 00 00 00 00 00 00 0	BOYGLOOD C STRUCT CONTROL T RED 2 COUNCINS S IN C 4151ER	31.40 66 81.40 67
801 SUMMD=SUMMD+TC(J)		84 vo 66
2 C.		60 0 76
		0.18
	XLF (K) = XFBIP	BL 70 72
	della programma della programm	Ft. 73
SUBPOUTINE BLYOUT	01	BL 10 7
	٥2	BLYO 76
SUBROUTINE TO LAY OUT FUSFLAGE CONSTANT U-VELOCITY PANELS		
COMMON/3PGEOM/SNT2(200)+CSf2(200)+2LC(200)+2HC(200)+THT1(200)+	2 0 0 0	
I TATE OF TOTAL TOTAL TATE OF TOTAL	BLYO 60 XCPT(X) sXFBIP+(1,0-FA()+0x	BL 70 800
COMMON /FSGFOM/FHMAI, SSPAL. FLIMC, HUDITPL	BL YO	
COMMON/INDEX/ACK+MS4+MS4P,NPANES+NC48+NEGERI-NROCP2+NHO+NHIP+M	. BL70 90 C	
TOLAN, EAST OF LOT AND	•	

Figure A-1(e)

NIELSEN ENGINEERING AND RESEARCH INC MOUNTAIN VIEW CA F/G 20/4
PREDICTION OF SUPERSONIC STORE SEPARATION CHARACTERISTICS INCLU-ETC(U)
NOV 80 J MULLEN, F K GOODWIN, M F DILLENIUS F33615-76-C-3077 AD-A099 331 NOV 80 J MULLEN, F K GOODWIN, M F DILLENIUS NEAR-TR-210-VOL-3 UNCLASSIFIED AFWAL-TR-80-3032-VOL-3 NL 20°3 \$9933

Figure A-1(f)

222323223

CONTINUE REWIND 6

120

STORE BODY GEOMETRY ON TAPE 7 NTAPT = NG CALL IOWRIT (7.A.NTAPT) RETURN

220

270

ŝ

CALCULATE COORDINATES OF PANEL CORNERS FOR EACH SEGHENT UP - INDEX OF PANEL NUMBER (TOTAL-NBUDY)

**...** 

(1987(2),51.0) WRITE (6.220)

Figure A-1(g)

۵,8

.......

Figure A-1(h)

Figure A-1(i)

...

Figure A-1(j)

35

2

...

ŝ

COMINGE RETURN END SUBROUTINE DPRHS SUBROUTINE DPRHS SUBROUTINE DPRHS COMMON / DASESO, FRANCE, PALCH, AND SIDE OF THE EQUATIONS FOR U./VINF ON THE WING. PYLCH. AND FUSEIAGE INTERFRENCE PRHSESSENCE ORMON / DASESO, FRANCE, FOUND & SUBREST, FRENCE PRHSESSENCE ORMON / DASESO, FRANCES,	B U-VIN GICAL CE HMON /BA: SUMK(7): HMON /BO! JOLZ: J JAEFA: RE	3 35 7 8281
---	---	-------------

igure A-1(k)

Figure A-1(1)

. . .

. . .

....

VEI(1): WEI(1): WP VEI(1): WEI(1): WP VEI(1): WEI(1):	DPRH1740 DPRH1750 DPRH1760 DPRH1760	12C = 101f0+321+180  LOOP THROUGH NUMBER OF BINGS IN SEGMENT OF INFLUENCING PARE BLOCKS. L - 140EX OF CROSS SECTION IN THIS SEGMENT	FLDV +10 FLDV +20 FLDV 430
C CALCULATE RIGHT MAND SIDE	_	KFUSOR = 10(1FU-17)	įį
C EING BOUNDARY CONDITION		DO 140 L#2.KFUSOR CALL FLDVL2 (A(IXPI).A(IYPI).A(IZPI).A(ITM).A(IDEL).A(IGB)	FLDV •70 FLDV •80
111 CONTINUE		<ul> <li>XFP+YFP,ZFP+U+V+W+SVN+LSKP+MFLD</li> <li>A(IXC)+A(IXC)+A(IZC)+KFUSOR+IXZSYM+JR+JG+L)</li> </ul>	FLOV 490
120 CIR(J) = (AEFACE+AEPHAL(J) + WICR) = CSPHI(J) + VEI(J) = SNPHI(J) - IVEI(J) = (UEI(J) = AEPHAL(J) + WEI(J) > -CSPHI(J)		JG E JG-JR CONTINUE Afternoon	FLDV 520
C PYLON BOUNDARY COMDITION		END FILE	FLDV 540
	DPRH1490 DPRH1900		
IFICENTER) VEIGU)#0. 130 CIRCUHVEIGU)	DPRH1920	SUBROUTINE FLDVLZ (XPT.YPT.ZPT.THET.DELTA.68.XFP.YFP.ZFP.U.V.W  Syn.LSRP.NFLD.XC.YC.ZC.*KFUSOR.IXZSYM.JR.JG.L)	
C FUSELAGE INTERFERENCE PANEL BOUNDARY CONDITION ONLY V NORMAL IS USED IN FUSELAGE BOUNDARY CONDITION	OPRH1940 C	COMPUTE THE THREE COMPONENTS OF VELOCITY INDUCED AT SPECIFIED CONTROL POINTS BY THE BODY PARIES OF A GIVEN BODY SEGRENT	100 20 30 10 10 10 10 10 10 10 10 10 10 10 10 10
13] IF INFU.EQ.0) RETURN 13] IF INFU.EQ.0) RETURN 10] 146 JANZPRANTOT		COMMON /BINLET / NINLET+NINVEL+NTINL+RVIVO+NINBLK+BTINLT+YCPI	
NB=1-N2 NB=1-N2 NB=1-N2	DPRH1490	• .xINLT:YINLT:ZINLT:XINLTE:YINLTE:ZINLTE:JINLTE:JINLT:ZI COMMON / JBLKAN/ COST:ZINT:XBL:YBL:XBL:XET:XCI	
146 CIR(J)==WW FRUGN FAD	DPRH2020 DPRH2030	COMMON / BODCOM AMACH-TAND-CK, KKORR 4) * CORT 4) * Z 1, Y 1, Z 1, X J - Z J - X L - Z L - X E T A 0 - 8E T A L - S L B S ON * S L P E R S - J	
		COMMON /BOPINS/ 1 JO.JZ.JO.NFUS.NRADX(5).NFORX(5).JZIEST.IPRES.ISOLV 2 .INETIIPLI(14).IPRI(5).UVW.XSIARI.KME	FLOV 140 FLOV 140
CHREGITINE FLOVEL (XFP, VFP, SFP, SVN, LSKP, U, V, W, NFLO, 10, 16)		3 .REFA.REFD.REFL.REFX.REFZ.CCTEST.ITMAA.BODL.121(12)	
C ROLLINF TO COMPUTE U.V. W VELOCITY COMPONENTS AT THE FIELD POINTS		DIMENSION XPT(20), YPT(20), ZPT(20), TMET(20), DELTA(20)  • .68(20), U(20), V(20), W(20), W(20), XFP(20), YFP(20), ZFP(20), SVN(20)	FLDV 188
C XFP.YFP.ZFP. ALL FIELD POINTS MAVE THE SAME BETA EXCEPT THE DECRATED INLET PANELS. THEY USE MINMUM OF BETAO AND BITNLT			FLDV 200
C COMMON A (12000)		LOGICAL LZERO-SUBSON-SUPERS LOGICAL INLISI-INLET-NOINLT-OPEN	FLOV 230
LOGICAL LSKPINFLD) . YFP (NFLD) . ZFP (NFLD) . U(NFLD) . V (NFLD) . W (NFLD) DJMENSJON . KFP (NFLD) . YFP (NFLD) . ZFP (NFLD) . U(NFLD) . W (NFLD)	FLDV 80	EXTERNAL INLISI LZERO = "FALSE. LZERO = GOD STELO MELATTONS, TWELLING ROTH INLET AND	FLDV 250
• .5VM(HFLD).1D(136) DATA IDLAST/-1/	100 130 C	ADJACENT SET OF PARKLS MINE TANDBEANINE	FLDV 270
INITIALIZE VELOCITY COMPONENTS TO ZERO.	FL0V 130		FLDV 290 FLDV 300
013W-1=1 010 00	120	COST 1 1 2 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5	FLDV 310
	170	COSO * 1.	FLDV 340 FLDV 340
ě	190	YCOA(1) #0.	FLDV 350
RENGTH	210 220 C	FF SE 1	FLDV 370 FLCV 380
	230 240 240 240	I IS THE INDEX OF THE FIELD POINT J IS THE INDEX OF THE INFLUENCING PANEL	FLDV 400
	FLDV 250 C	INITIALIZE SKIP LOGIC CHECK ON VELOCITY CONTRIBUTION	FLDV 410
ITM w IO(45)+IA0 IOE, w IO(46)+IA0 IOE, w IO(46)+IA0	288	00 20 1=10FLD SVN(1) = 0.	FLDV 440 FLDV 456
A E	9 6	SETUP LOCAL GEOMETRY FOR IMFLUENCING PINEL OF RIMG JB	FLDV 460
	200	DO 60 Melled R	FLOV 490
2 ·	FLDV 340	X 00 T T X V (1) T X V (1) T X V (1)	FLDV 510
120 JG = 0 0 150 [FUe] KFUS D = 10/fell:31=1		ZBTJ = ZPT(J) TAND=TANIDELTA(J))	FLOV 530 FLOV 540
IXC = 10(1FU-22) - 1A0	FLDV 400	COST=COS(TMET(J)) SINT=SIN(TMET(J))	FLDV 550

Figure A-1(m)

Figure A-1(n)

ے ہ

:=

............

**32**00

ç

Figure A-1(o)

1				į
IF (FORDAIN) - LE. G. G. TO II	FUSE 819		0 = 000	6.0 m 6.20
	FUSE 620		0 • 001	6E0# 630
			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	000 MO39
CALCULATE FUSELAGE SMOCK WAVE SMAPE	FUSE 840		(C) (E) (E) (E) (E) (E) (E) (E) (E) (E) (E	6.0H 6.50
LB17E (6.734)		U		GEOM 670
CALL SHESHP INFSOR.FAL.FSS.BETA.FRHAX.BTNOSE.NFSHR.FESHR.FRSHR)			ALPIA = 0.0	6E0# 686
PRET CURIN			BETA = 0.0	069 1039
CNO			0.5 F. C. S.	
			20 L 1 20 C	6E0M 720
			PEFX=0.	GEO# 730
			REF 2 = 0 •	BEOM 740
SUBROUTINE GEOM	GE 04 10		XSM_DR = 0.0	6COM 750
			C GZIRAL	6E0# 766
INPUT CONFIGURATION GEOMETRY AND COMPUTE PANELS		·		
			TABLE CONSTITUTOR DADAMETERS	000 TO 100
TABLE CARGE OF DEAD TROUT		· u		6E0# 800
			READ (5.150) TITLE1	GEOM 810
REWIND	6E0M 80	?	WRITE (6.170) FITLE!	GEOM 820
BODPAN, MAITE APT., ZC - SAVE BODY GEOMETRY	GEOM 90	۰		6EOM 830
	001 H039	J	PRINT AND CONTROL OPTIONS  DEAD AS 100 TAXABLE TOOK TOOK DESCRIPTIONS TO SECOND STANSON	GEOM 840
TANKER OF OF THE VEHICLE OF CHARLES	200		TERU TOTION INCOMENTATION TOTAL CONTROL OF THE CONT	GFOR BAD
COLOR TILL DIAG TRADE	6FOM 130		STEEL STATE	GFON 870
ACAD Y8, Z8 - PER SEGMENT	6E0M 140		INLET = NTINLONE.0	0E0M 039
REMINO	6EOM 150		IF (MAXSHK.EG.O) MAXSHKH7	6EOM 890
	GEOM 160		IF (LPRT) WRITE(6.220) IAZSYM.IPRT.IUVE.NSHOCK.MAXSYK	GEOM 900
BLANK COMMON USAGES	6EOH 170		. NINLET.NINBLK.NINVEL	6EOM 910
	160	٠,		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
(1) AFTER CALL TO COMPTG		,	DEAD 16.250 ADID BANDARIES DAD	00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
37 CA - 142	65 M 216		IF (LPRI) MRITE(A.230) MRIP.XSMLDR.FALPKA	GEON 950
2 M (	8EOM 220			GEOM 960
(3) AFTER CALL TO BODPAN	6EOM 230	U	GEOMETRY DEFINITION OPTIONS	650# 970
XPT. YPT. 2PT. THET. DELTA. AREA. XC. YC. 2C. YB. 28	GEOM 240		READ (5-184) JO-J2-J6-NFUS-(MRADK(I) .NFORK(I) .I=1.NFUS)	GEOM 980
	6E0M 250		IF (J2.E0.0) J2*-2	066 MO39
COMMON /86EOM / MFUS(51).2FUS(51).FUSARD(51).FUSRAD(51)	GEOM 260		IF (LPRT) WRITE(6.2.0) JO.JZ.J6.NFUS.NRADX.NFORX	GEOM 1000
• FUSAZ(S1).XJ(S1).PMIK(33)	GEOM 270	, ن		GEOM1010
COMMON / DINCET/ NINCET-NINCEL-NINCHORNING NINCET-TOPI	65 UM 280		COMPUTE ARRAY LENGTH	6E0M1020
ALINITATINITATINITATINITE OF THE	2000			50 CM 10 30
COMMON /BINSHK/ NISAKISHCO-EACHIOACCCOSCAMANSMIANINCOSCAMINCOS	000			CEOM DE C
Chesary and a second of the contraction of the cont	GF OM 320			0001000
COMMON / MODELINS/	6E0M 330	U		GEOM 1070
JOS-JZS-J6-WFUS-NAADX(S) -MFORX(S) - JZTEST, IPRES ISOLY	GEOM 340		00 50 NFU=1.WF	6E0#1080
2 SINLET-IPLOT(4) - IPRT(5) - IUVW-X51ART - XWLE	6EO# 350			6E OM 1 0 9 0
3 SREFA. REFO. REFL. REFA. REFA. CCTEST. ITMAX. BOOL . IZ1 (12)	GE OM 360			9EOH1100
COMMON /8SHOCK/ NSHK(10),PH[S(10),THETN(10),MAKSHK+NSHOCK,08ETA	GE OM 370	i	MAXNX B MAX  AXNX NFORK (MFU))	6E0M1110
* .EALPMA.CNUG.CNUZ.XSMLOR.SHK (31.XSHK (100).RSHK (100)	GEOM 360	20		GEOM1120
CORECT / CONTROL ZX-ZZ-XX-XX-ZX-ZX-XX-XXXX-XXXX-TAXXX-XX-IOI	GEOM 390			6E0M1130
* ************************************	0.00 M MO 40	_	15 (1531) 8-1-15 (0:354)	66.0M1140
LAN-1AN-1UB-1C08-77-1VB-1U-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	GEOM 620			
. MAGS-MAP-NAK-NASS-MASS-MAFLD-JAD-JOD-JSKO-JZ2(4)-NAJNG-JROE(5)	01 GE OM 430			
COMMON /MEAD / TITLE1(20) .TITLE2(20)	GEOM 440	٠,	READ EXTERNAL CON- SURATION GEOMETRY	GEOM1180
こうかんしょう アンカスター / アカアにコットにアコン・ロットにアコン・アンスト・アット・アット・アント・アント・アン・アンスト・アンスト・アンスト・アンスト・アンスト・アン	DEC HOLD			2001120
ONLY				95 CH   5 VV
	660M 480		IF (LPRT) WA E(6.170) TITLE2	GEOM1220
OIMENSION 10(130)				GEOM1230
EQUIVALENCE (10(1) .Nx)		، ن	INPUT REVISED CONFIGURATION PANELING DESCRIPTION CONTROL INTEGERS	GEOM1240
LOGICAL LPHI.NEAPHI.ESIMLET			KFUS a MEUS	C 041250
MENDAL FALSE.			READ (5-180) KO-(KRADK(I)-KFORK(I)-IBI-KFUS)	GEOM1270
00 20 1=1+32			IF (LPAT) WRITE(6.250) KO-KFUS-KRADX-KFORK	6EOM1280
MAADX (1) * 0	6EOM 550			GE ON 1290
0 1 (1) 01			READ INLET PARAMETERS	6E0#1310
NADIM = 40200				GEOM1320
	6504 590		IF (INCEL) ************************************	6£0#1330
				***

Figure A-1(p)

	REVISE BOUY (FUSELAGE) "ERIDIAN LINE SPACING, THEN  CALL NEWRADISTU)  DEFINE NEW AXIAL STATIONS	6 6 0 4 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
	00 of 5	
0) WRITE(E6.10) (JIMLT(!!):I:MP].MTIML) GCOM1300 (DCOM1420)    FEFAR.REFD.REFL.REFX.REFZ	00 of 5 uSoR	
	000 v 06 s uson	
	06 5 00 5 S	
	06 5 'USON' "11.	
	00 5 USON :=11+	
	06 5 USON	
	06 s .usoR	
	00 5 USOR	
	06 5 USOR	
October   Octo	00 5 USOR	
	00 5 USOR	
	06 5 USOR	
MANCR = 0	06 5 USOR	
MAKAR = 0	06 5 USOR	
MAGON = 0  KKRR = 0  MATOT = 0  M	OF SEGME) USOR-1) 	
MANNER B WARRER WARRER B WARRE	OF SEGWE? USOR-1;	
MATOR	OF SEGME! USOR-1) =11.62)	
CHARD   CONTRIBUTES   CHARD	OF SEGME! USOR=1; =11.12; USELAGE)	
FILEST   MARCH   MARCH   MARCON   MAR	OF SEGME? USOR-1)	
F (READLEG.) READLESSERIES   F (READLEG.) READLESSERIES     F (READLEG.) READLESSERIES   F (READLEG.) READLESSERIES     F (READLEG.) READLESSERIES   F (RESTEADLESSERIES     F (READLEG.) READLESSERIES   F (READLESSERIES     REAR E ANARCHARGE (READLESSERIES     HARDY R. HARDON-KAZ-PEKRAD   HARDY R. HARDON-KAZ-PEKRAD   HARD R. HARD HARGE (READLESSERIES     HARD R. HARD HARD HARD HARD HARD HARD HARD HARD	OF SEGNE? USOR-1) =11+12)	
	OF SEGME! USOR-1; =11+(2) USELAGE)	
	OF SEGME! USOR-1; =11+[2)	
If IREST   STATE   SECURIOR   SECURIOR	OF SEGME! USOR=1; =11.62)	
KARS = KARNETSOR=KRAD	OF SEGME!  USOR-1:  =11.12:	
NEW REAL BANK	OF SEGME! USOR-1; =11+f2; USELAGE;	
NATE	) / FLOAT (KFUSOR-1) 1) U+ (KJ(K) + K#11+12) ON BODY (FUSELAGE)	
MENON = NABODY (KRAD-1)* (FUSOR-1)  MENON = NABODY (KRAD-1)* (FUSOR-1)  MAG = HARDING-Z*NXRR  NG = HARDING-Z*NXRR  FEST = NABORE (FISS)	) / FLOAT (KF USOR-1)  1)  U+ (KJ(K) + K*11+£2)  ON BODY (F USELAGE)	
CONTINUE  NOTICE ALCOMARIANTE CONTINUE  NOTICE ALCOMARIA 3 - MAKE  NATOT = NAG  COPECK ALLOWABLE DIMENSIONS  FEST = MAKER, 67.33  FEST = NATIBLES & NOECOM, - PMIK  FEST = NATOT - PMIK  AND NOTIBLES & NOECOM, - PMIK  AND NOTIBLES & NOECOM, - PMIK  FEST = NATOT - PMIK  FEST = NATO	1) U+(XJ(K)+K=11+£2) ON BODY (FUSELAGE)	
No.     No.	1) U+(KJ(K)+K=11+£2) ON BODY (FUSELAGE)	
######################################	1) U+(KJ(K),K=11+(2) ON BODY (FUSELAGE)	<b>, , , , ,</b>
	ON BODY (FUSELAGE)	, 0 0 0
/86EOM/ - PHIK  /86EOM/ - PHIK  /**AMCOS.AMSIN.7F.ZF  GEOMITYO  GEOMITY  GEOMITYO  GEOMITYO  GEOMITYO  GEOMITYO  GEOMITYO  GEOMITYO  GEO	ON BODY (FUSELAGE)	
	ON BODY (FUSELAGE)	
6 (COM 170 6 (COM 180 6 (COM 190		9
	NIIN = NINLET *NINBLK	
V8GEON - PMIK   GEONITY	CALL BUDPAN	9 0
### ### ### ### ### ### ### ### ### ##	MOLLIAGN	0503F036
6 CEM BB 0 C C C C C C C C C C C C C C C C C		
6001807 15 6001807 15		
6 COM 150 160 160 160 160 160 160 160 160 160 16	FORMAT (2044)	9
17. (1907) WFADA.W OFF. NAT. (1907) 17. (190	į	
RITE (6.350) NATOT-NADIM GEORISON 220 FOR SYMMETRIC MALF OF 8000Y	FORMAT (1M1-//SK-20A+-25K-12K++ GFOM +++	
RITE (6.350) MATOT-MADIM GCOKIESO FOR SYMMETRIC MALF OF BODY	101417 TEND	00000000000000000000000000000000000000
FOR SYMMETRIC MALF OF 800Y	SHPANEL SYMMETRY OPTION	75.
FOR SYMMETRIC MALE OF BOOY		
Stab.Ed. 0)		
(RAD_EG_0) 60 TO 100 (GEON1950)  ADA(1FU) (GEON1950) (GEON1950)  (GEON1950) (GEON1950) (GEON1950)  (GEON1950) (GEON1950) (GEON1950)  (GEON1950) (GEON1950) (GEON1950)	CATACAN CALCAN C	
(RAD.EG.0) 60 TO 100 GEON1930  GEON1950  GEON1950  GEON1950  GEON1950  GEON1970  GEON1970  GEON1970  GEON1970  GEON1970		
(RAD.EG.e) 60 TO 100 (GCD41950 ADX.11FU) (GCD41950 23 GCD41950 23 GCD41950 23 GCD41960 23 GCD41960 24		.15.
ADX (1FU) GEON1950 23  • GEON1970 GEON1970		NBLK1 # .15. GEOMZ680
6(6)4)50 23		. 15
60 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FORMATION	9
## I HA I	* /5X+50HX+[DE FOR JATEMPERED SHELL GEORGEMY (ABIP)	ABIP) #1612.5.6
MENT PMI GEOM2000 24	/SX1-50HRATIO FOR SHOCK ROTATION WITH ALPHA     (EALPHA)	PHA) = 612.516E0M2730
0.001033	FORMATI // 154, 35HEXTERNAL GEOMETRY OPTIONS AND SHAPE	GE 0M2740
0.02010	. /5x.50HREAD REF. AREA CARD IND=0.YES=1) (J0)	
DELE # 1800-76 ANG CEUMO222 CEUMO22 CE	• /5x.5oHEXTERNAL GEOMETRY TYPE • /5x.5oHOFAO 2_CENTED: THE /MOLACE WEELA:	
04024039	- /sk-Schwuder of Booy Srewers	: :
60 70 90	. /46X+945EGMENT +25H (1) (2) (3) (4) (5) ,	GE ON 2 1 40
09020039	- /5X.50HNUMBER OF GEOMETRY CORNER MERIDIANS (NRADX)	ŝ
READ NEW MERIDIAN ANGLES FOR SEGMENT	* /SX+SONMUMBER OF CROSS SECTION ANIALLY  **OBSET************************************	ŝ

Figure A-1(q)

Figure A-1(r)

37.0

380 390 000 07

Figure A-1(s)

**2**0000

Figure A-1(t)

Coop walte (6.06) JOHANICHITO		- Indeligation (Grant Section )   Control of the Co	091 1191
PASSES FORTRAN VERSION concentrations and the second	007	1-44.0 (Par-1	
	10mg 250		
##17£(10) A	10we 230		
ONS	10mm 25e	C MERIDIAN LINES DEFINED BY NAME IN THE GEOMETRY INPUT	4 2
		CONTRACTOR INDESTRUCTION	: : : :
		C IF ATESTED CIRCULAT OR COMPUTE NEW YOU'S OBSIDED. C IF ATESTED ABBITTED TOOMY JOSE OBSIDED. Y. 205	M =0 200
SUBROUTINE METCLEIS.DP.MCH.NCHI.MSH.MSHI.MSHAI.PSILE.PSITE.	METC 10	ATESTRO	4
	2 2 2	(# (J2TEST.FO.),#250,#280,F0.0) #1FST#] IN .#8880.f0.0) #281.#88801[F0.]	* *
THIS ROUTINE CALCULATES THE NET STRENGTHS OR THICANESS	METC 40	ADDRETTO B TOBO	3
•	200	ATA B MACORILIFOLOGISA ON SAMONE (1901) GIRBADILI	4 1
	ME7C 70	128 = 178 · NT	3
Parl (MSel)	# 7C #	CALL   PRESTON-181  PROTEST   PROTEST   PROTECT   PROT	* *
	METC 100	•	100
SET P ARMAN TO REPO	MTT 120	C SAVE TO AND ZB FOR EACH SEGMENT	3
MCB2swCa-2	METC 130		9
	A 77 35	ISE = [SF.2ewaghar]Fulled   Garage   SF.   SF.   Sewaghar]Fulled   SF.   SF.2ewaghar]Fulled   SF.   SF.2ewaghar]Fulled   SF.	4
	METC 160	INE - INE-MODELIFO	1
STORE S APPAY IN P. LEAVING & 2FRO COLUMN UNEMER BE A	100	O# 3	3
	METC 200		
	METC 220		•
_	# 1	**************************************	, ,
a) -MCu	MTC 250		g .
	METC 230	C HOUSING TO PERFORM NADIAL INTERFICALINATION OF UNCOMPANY.	
IF (J.EQ.#S#) 60 TO 18	METC 200	JATEST # 1+ Clac Laszfilletic FUSELauf with NO 800+ Ca	3
	# 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		
	METC 310	DIRECTOR SURON DE ACTUEDAD DE CONTRACTOR DE CONTRACTOR	4
	22.2		11
CALCULATE MET STRENGTH/THICAMESS	# 7C 350		1 1
	250	DIMENSION THINK JSON ARBOT - ZHINK JSON ARBOT - PHIN (ABAD)	g (
DO 20 Jal. 1974	# 77 × 27 × 27 × 27 × 27 × 27 × 27 × 27	**************************************	7
	:	•	30
1.200 Declaration (1.1.1) 0.4	:	COMMON /BOWLAS/	
	METC 410	1 00-12-04-WG US-NHBUR (4) - NF UNR (5) - U218 ST . 1945 S-150LV	7 9 34
RETURNS FIND	# TC 138	2 - IMERTO POLOTION - PATISHOUND AND AND AND AND AND AND AND AND AND A	Me an 210
			2 9
		)	3
The state of the s		0414 8400.605.00.0017453203.1.6.0/	4 4 5
	.3	Change of Oc	2 0 0
BECNER BOOK (FUSE BGE) BERNING SPACING BOOK DEFENDED FOR A CAMENTA	: : !!	14 1.27ff57.80.31 GO 10 30 PY (4.4) 1 PY (4.4) 1 PY (4.4) 1 PY (4.4) 1 PY (4.4)	
	3	10 • \$1	M. 40
COMMISS / MEGNO / MEDSING AND	3:	FILTO B FILTING A "INDOOR"	7 9 7 9
8	:		1
1 UB-UZ-UB-MFUS-NABOR(S) - MFORR(S) - LZFES** (PWFS-150) V	; ;	30 CONTINUE	# 1 4 1
S - SECTION SECTION FOR THE SECTION STATES AND SECTION	=	COMPUTE INTERMEDIATE VALUES ANOUND CINCUMERRINEE	4 W
COMMINS VONSTRUCK SEALES SEALES WINDS SEALES SEALES FOR SEALES SE	2 2		2 2
CONTRACTOR			

Figure A-1(w)

	MULY 798			20,71333
AND TOT ENDING - With	MALY 800	50 JJC#JC#MCPI+NPI#		50CV1563
				*LL 7 1550
MATTER REPURSIONS		WPT (JCNHd) avic (Jupl)		*CL 11570
	MC 4 840	ZPT (JCNRW) #ZLC (JJP1)		WL 71580
LATOUT DATA FOR CONSTANT U-VEIOCITY PAMPLS	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	19 55 1=1.4CF		MIL 4 1940
#1.m	MA. 7 870	10-770-1		MULT 1610
	MULY 840			WUL 7 1620
JC = 6	MA. 4 000	NA VETCIONNETTE (17)		ML 7 1650
Richard Care (1-gr) agr)	MULY 910	SEP(IC-1) =SEPPTE(IP)		MULY 1650
1.arelar		60 CONTINUE		M.R. V 1660
	M	8007 - PAMFLS BELOW WING	92.1	MA. T. 16.50
	MULY 958			MUL. 7 1690
CORNERS ON RIGHT SIDE OF PAMEL	MULT 960	65 If (NFU.EQ.0) GO TO 90		MUL V 1706
	MA. 7 97	300 m 1		MAC 7 1 7 20
29f (JC) = 29C (JJP) 1	MULY 998	IF INBOCRZ.EQ.0160 TO 85		MULY 1730
( ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( (	M. V. 1000	(1 = 1)		MUL 71760
Challeton attachmic control	MUL V 1020	70 CONTINUE		MAL V 1760
I-diffed!	MUL 7 1030	50.10.40 JO		MULY 1770
	MALY 1040	ON - 47 E E E		MA. 7 1780
(1) = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1 =	MUL V 1060	JCG-TC-WARE		MUL V 1 606
	MUL V 1070	CUCE CUC-11 PNCKB1 -NPTEP		MALY 1810
Septice: a Sepone (ip)	MUL 7 1000	797 (CCB) #4FC (CA)		MALY 1820
IF (JP. EQ. MSW160 TO 30	MUL Y 1 1 00	SABP (JC) #SN72 (JP)		MULY 1848
IF (#STMLE (JP-2) .EQ.PSTMLE (JP-1) .ANO.PSTMTE (JP-2) .EQ.PSTMTE (JP-1)	MUL V 1 1 10	CSGP (JC) #CST2 (JP)		MA. V 1850
own of the contraction of the co	MAC 7 1 30			MA. 7 1860
CORNERS ON LEFT SIDE OF PANEL	MULY 1140	201 (JC8+1) #28C (JP9)		MAL Y 1886
	MC 7 1 50	(のつ) ベトナジャ (1・10つ) ののより		MA. 7 1 8 9 0
Se JAC SAC SAC SAC SAC SAC SAC SAC SAC SAC S	W. 71	[X189 (LC+1) = 1X1 (LP)		MALY 1910
491(JC) #4LC(JJP1)	MU. Y 1180	00 75 I=1.NC#R		MUL V 1920
291 (JC) = 2CC (CJC) = 1	MUL V 1 200	19#(1-1) *W80*JP8		ML 71930
	MUL V 1210	APT (1C) *ALF (1P)		MUL V 1950
DO 35 1=1:MCM	MULY 1220			MUL 7 1960
i de La constante de la consta	MULY 1240	APT([C+1) = ALB(1P)		MA. V 1980
	MU. V 1250			M.A. V 3 990
35 Sef ((C) a Sef Pp ( ( P ) )	MALY 1260	80 CONTINUE		MA. 72000
SEPTION SEPTION	MUL 7 1280			MULY 2020
40 CONTINUE	MALY 1298	- PANELS ABOVE WING		MULY 2030
PYLON	W.V.1310	85 J1 = MBDCR2+1		MALY 2050
	MA. v 1 320	J2 = 480		MA. 72060
	MULY 1340	60 10 70		MA. 72080
45m 1 m 6 00	MU. 71350			MUL V 2098
	MALY 1360	AD ANALOS: 40 CALCAS AND CARENGE AND AND CARENCE AND C	STRENGTHS FOR INPUT	MUL 72100
JUCALCHICP1 AND TH	MULY 1380	משביים היינים	3044016 3116 300 to 1	ML 72120
JC=JC+1	MULY 1396			MALY2130
CONTRACTOR AND CONTRA	M. Y. 14.00	IF (WBDCR2.EG.0) 60 TO 89	•	MULT2140
297 (JCM24 ) = 23F (JCM2)	MULY 1.20	261=1		MAL 72160
DO 45 1=1-MCP	ML 71430			MALY 2170
	MAY 1050	B7 CONTINUE DO MA JADAM JA1 192		MAL 72180
RPT(IC) = RPT(IP)	MULY 1460	JACK CHORDEN ON CHAR		MAL 7 2200
45 SUPICION SUPPLE (IP)	MULY 1470	JOLD BURNA		MA. 72210
XF1 (10-1) *XX6 (10-) X86 (10-1) *SX60F( (10-)	MC 71490	DO RE INIONER INEWANER-I		MULY2220
[FIJP.EQ.#SP]GD TO SO	MULY 1509	1000 08 01-13 00 00 00 1010		MULT2240
F. PS PLE(JP-2).E0.PS PLE(JP-1).AND.PS PTE(JP-2).E0.PS PTE(JP-1).	M. VISIO	SATZIINEMI BOELTPITOLDI		MALY 2250

Figure A-1(y)

Figure A-1(z)

The state of the s

Figure A-1(aa)

9

283

\$000

Figure A-1(bb)

Figure A-1(cc)

.....

	DHDk=DADX + (2,0*X • C(J,2) • C(J,3)) '(2,0•5QAT(AAG)) • C(J,7) AETUAN END	SHAP 1	170	50 47 44	\$1 TVU=ATAN'TANNJ1 =57_2957/95 SANOWQ2=BANGNJ1-TVU 57_2957/95 51	# \$ 680 # \$ 690 # \$ 700
	}	•	;	1F (		SMS 710 SMS 720 SMS 730
	SUBROUTINE SHASHPINC. 15.55.8ETA. PHAILBINOSE . NSHA. 15HK. PSHK!	SHKS	2	3 7	CH#50RT(8ET#YC*8ET#XU*1.0)	#5 760 #5 750
٠,	Capitalia and Aports and Action and Sales and the Artificial and	SHKS	2.0	9 2	60 TO 51  SPECIAL CARGAGO 100 - ACAD TASTOR (2.07), D. C.	MS 760
, <sub>(</sub> ,	AND SUGRECULTIVE CALCULATES STATE OF STATE OF ATTACK	SH				1KS 760
	DIMENSING ASSESSESSESSESSESSESSESSESSESSESSESSESSE		2 3	2 2		** S 600
^	TOT FORMATIZENS INNESTEINTENTENTENTENTENTENTENTENTENTENTENTENTEN		2 5	- =	5) 327807NUSQ) 10005 (TNUX57,2957795)	SMKS 810
ŕ	1 GA:37UA/UA/ 702 FORMAT (201:15.2F10.4.5F10.5)			. 8	ANU-SORT (FAURCH-FAURCH-1.0)	MS 830
Ų		SHES	901	<u>.</u> #	IF (BETANU.GT.BINOSE) GO TO SI BETANUEATNOSE	SHKS 840
, ,		SMKS 1		Ž	Jalat Ja	MS 860
	4017E (6.70)	SHKS			ASTR (NOTR) #ASTR (NOTR-1): • 0 . 5 • (BETANC-BSAVE) • (B-RSTR (NSTR-1): ) SPRSK (NOTR) #R	14.5 B 70
	25.55 (L) ±0.0	SPAKS	150	ž.		¥ 5 690
	ASKR B.	SHES	100	¥ W	MARITE (0+707) NOMA-EXDAR(NOMA)-R-COMPETENDAVE-FNORTH-METAND-DROK ) TESTA-8FTA-8FTA-NOTA-BETA	145 400 445 410
	0,011	SHKS	90	<b>*</b>		4KS 920
	FELTANORICATIONS HOUSE - 1.0)  EDING (A. 100) ASIK - XSIK - XSIK - 10 - 05 SIK (1) - C - 2 - FEL - BIXOSE	SHRS	202	<u>.</u> <u>.</u>		# 5 4 30
	DRO. SeRIAX	SHAS		55 85 52 85		* 950
	ZO+7457	SHS 2	230	Š -		45 950
	0.4×0.1	SHKS 2	240	<b>±</b>	0.50 ) RETURN	4KS 980
	BSAVE #8TWOSE	SHKS	520	8		4KS 990
	angacisco-e-byserances	SHKS	270	2		44 S I 60 B
ų (		SHKS 2	280			
ں ر	MADIAL LUCATION LOOP	SHES	300			
	S Park-DR	Sers 3	310	3	SUBROUTINE SMARCH (GB.VR.IA.IMAGE)	
	AVIX HAVIX + 1		ں ر	MARCH		SWAR 30
		SHKS	, ب	SOLUT	O INFLUENCE	
Ų		SHES	ں ر	5 1	DUE 10	S#48 50
u (	X LOCATION LOOP	SHKS 3	٠,	PRESE		
	10 Karox	SHKS 390	, ب	;≥	IV = STARTING LOCATION OF VB	8
ں ر.	CALCIN ATE SOURCE VELOCITIES	SHKS A		2		
U		SHKS	2	ខ	COMMON /DIMENS/ IZOIM(79) .NRING.IROB(50)	
		SHKS	U 904	3		
	Ja Ja WC	SHKS +	9 9	6 5		SMAR 150
		Shres	2 2	35	CALL JOREAD (9.1POW.MRING)	
	•	SHES	000	89		148 180
	3.0	SHKS 5	0	8	150 18±100 NR1NG	
	ACCONTACC (ARG-FOOT)	SECTO	0 0	Z Z	100 (100) 100 (100)	SMAR 210
	ETA-ROOT	SKAS		5	L TOPEAD (9.A(TA).NR)	
	U=U-1.0 IF IM.17.MSAVE) GO TO 20	SHKS D	Ü	16 01	olagonal Block. Solve Simultanbous Fourtions	
		SHKS 5	٠.			
	USAVE = U	STES 5	570	<u> </u>		SMAR 270
		SPECS	9 6	==		
	20 IF (MM.EQ.3) GO TO 30	SHKS 6	009	58	6-1)-(8-1-18-1)	SMAR 300 SMAR 310
	DX 0 1 - 0 X	SHKS				
•	50 TO 10	SHS			20 00 1 2 00 00 00 00 00 00 00 00 00 00 00 00 0	
<b>ں</b> ں	CALCULATE NEW MACH NUMBER AND BETA	SHKS 6	650 640 0	f04 N	FOR NOW DIREGNAL PLOCKS. SOLUTION OF PRECEEDING PINGS IS KNOWN ST	SMAR 350 SMAR 360
u		SHKS 6	J	EXPL1		

igure A-1(dd)

	}	The state of the s	
	SPE 340	**************************************	30. 4.05
	00.	はの ・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・	50. V ACC
120 CONTINUE	c :	**************************************	14 A 705 4
	,	[ Fr. 1 8 3 5	30.4 4.05
0.4>1	Û	CLAMBER / Bufum / Breef Pall . 25 Cartain Sauce Jane 12 Land Comment	305 A 705
I TP-IA		* 15.542.531.44.1611.44.1838	50. v 516
Sum = 0.0	09	COMMENS AND SOME TO SOME THE STANDS OF THE S	250 4 755
HO 1300 001 00	ت د د د		501 x 530
(7) E9+ (71) + E75	3 3	VIO. 16 1	50: v 550
130 10 # 1JolPA	200	2 . ATMLETTERS A IN THE TENTON ASTANTABLE	504 56
	214	3 WFFA. HEFL . WFF A. WFF A. WF CTF CT. 1 "MAR. B.C. L. 121(12)	205 5 205
0	950	まい・シーエル・ジャエ・ブローの () () () () () () () () () () () () ()	5C. V 5BC
	066	1 - SINAC C SAC FAILSPAISSINE	SOL * 596
3 × × × × × × × × × × × × × × × × × ×	0 0	のこの第四の名(Alberta Alberta Albe	201 4 900
CONTRACTOR OF THE CONTRACT OF THE CONTRACTOR OF	0.44	・ 「	200
410450	270	The origination of the second	201 4 650
WHENE IME INFLI	200	DECEMBER - 1.271.0 TOTAL CONT.	15015001 640
REMOVE .C. IN C	940	COMMON A 12006)	50°1 656
	SMAK 600	LOGICAL SURSOM+SIPEPS	50" × 666
	SMAR 610	LOGICAL INLIST. INLET. OPEN	SCLV 670
10 00 m	020 444	UPIR MADUE 6/0.0[7655/260]	100 100
	2 4	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	30F A 04
		このではない。	50. v 716
		SUBSON = XMACH.[1.1.	50° × 726
		SUPERS # XM4CM.61.1.	50 × 730
		ALPHARALPHAC	\$0° ∧ 3 ♦ €
SUBROUTINE SOLVE (IALP)	50.4 10	ALPEACHING TO THE CONTROL OF THE CON	S0. v 75.
	2000	2 300 4 x 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	200
SOLVE FOR THE STRENGTHS OF THE BOOK SOUNCES	201 × 30	CONTRACTOR OF THE PROPERTY OF	2014 705
PANEL CONTROL POINTS.	SOL ¥ 50	O. Inlag	50. V 74.0
	50LV 60	0.0=1mds	50L* eco
C THE PROGRAM MUST SOLVE A SYSTEM OF LINEAR EQUATIONS OF MAXIMUM	SOLV 70	SINB=0.	SOLY 616
CHOEF 1600. FOR SIPPRSONIC FLOW. THE SOLUTION IECHNIQUE CAN BE	e e	SINAESINAC	20 × 105
C. CHACKETERS BY B. CORNELLINESSON BY TROUGH CO. CHOCKETER TRANSPORTER OF TRANSPORTER TO THE TRANSPORTER TO	501 × 100 C	THE NOTE THE REPORT OF THE PROPERTY OF THE PROPERTY AND THE PROPERTY AND THE PROPERTY OF THE P	201 x 84.0
C CORRESPONDING TO THE MEATINGS NUMBER OF PARELS BADOWD & PING. THE	10		356 4 705
E MATRIX ELEMENTS IN EACH PLOCK AND CARFOLLY CHOSEN TO HEPHESENT A	50LY 120	IF 11x25xm.EQ.0) GU 70 20	50.1 860
C MELL DEFINED FEATURE OF THE OHIGINAL CONFIGURATION. FOR HOCY PANELS	SOLV 130	(lxd) \$0.3 = [red)	50r x 810
C. FACH BLOCK REPRESENTS THE INFLUENCE OF ONE HING OF PANELS ANDUND	50LV 140	[1836] N S N 1845	20° × 30°
C. THE BOOK ON BACINES HING. AND HINGS THAT BO DEFINITION BEING BUILDING BU	50LY 150		2014 630
C OF THE UPPER TRIANGE OF THE MATHIX ARE ZENO. THE SOLUTION IS	SOLV 170	BE TASASINISINB) ZHADDEG	314 4705
C OBTAINED HY SOLVING EACH DIAGONAL BLOCK SEGUENTIALLY AND SUBSTITUTING	350LY 190	AI PHA=ASINISINAI/RADDEG	SOLV 920
C BACK INTO THE REMAINDER OF THE MATRIX .	3		SOLV 430
	2014 500 50		205 A 705
APPRA LIMITS OF THE MAXIMUM NUMBER OF SINGS. (2) THE MAXIMUM	30CV 620	NIN = NIN(E1+) (NBLR	2014 461
NUMBER OF PANELS APOUND A RING. AND 131 THE TO'AL DIMENSION LEN	50LV 230 C		20FA 416
OF BLANK COMMON.	2016	CALCOLATE NORMAL VELOCITIES REGUIRED TO SATISFY HOUSDAY	201 × 540
	2007 4705	CONTRACT TOWARD TO A CONTRACT CONTRACT	200 A 200
ARGUMENT LISTS	50' V 270	IF (IALP-LE.0) IALP=1	0101A-05
IALP - INDEX OF SOURCE STHENGTH VECTOR, IGHTIALPT. WHICH TELL'S	50C* 24c	104:12(P) = NG.(12(P-1).NHOOY.)	Sec. +1026
MARRIE IN ARRAY - A SOLUTION IS SAVED. TAIN ALLONS INC	20° v 29°	To a 168 (14LP) • NaOOY	30, 416.30
STOWNER UP SOLUTIONS FOR MULTIPLE ANGLE UP ATTACKS.	50LV 30G	ACCOR* OF A MILE	2014 1040
OVERWRITING PREVIOUS SOLUTIONS	50C# 326	100 H 1 H 1 H 100 H	2014108
	50LV 330	1V8 = 1U	50. V1070
***************************************	-50LV 340		SOL # 1080
- SA TOS AL BORDE STATE OF THE COLORER	50c ¥ 360	1-0 + 1×0	201 1 105
TAPETE SOLVE. MEWIND		JOEL # 10EL+JM1	5011110
\$01.VE	501 ¥ 380		50LV1120
SMARCH.		「	2011305
			20111150
C BLANK COMMON USAGE IN SOLVE.	201 4 4 50 501 4 4 50	これに 一番 ほうしん アンドラン・ファット ひょうしょう アンター・プロック・ファット アン・ファット アン・ファン・ファット アン・ファン・ファット アン・ファン・ファン・ファン・ファン・ファン・ファン・ファン・ファン・ファン・ファ	501 4 1 1 60
· ·			1

igure A-1(ec)

		9 4 4 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
2004 130 200		
200   200	##(1) # (YC(2) - YC(11) / CK ##(2) # (YC(2) - YC(2) / CK ##(2) # (YC(2) / CK ##(2) # (YC(2) - YC(2) / CK ##(2)	
2001/130 2001/130 2		
2004 130 2004 1	######################################	
200   100   200   200		
20011130 201130 201130 2011	See Table: Lane:	
2004 130 2004 1	F (AS)   COLUMN   C	
200   100	ABSILAM.	
2004 130 2004 1	#### Spair ### S	
200   10   20   20   20   20   20   20	A   A   A   A   A   A   A   A   A   A	
20041350 201	PH_GCG_SM_  YIT X = Lett    YI	
2011130 201130 2011		
\$00,1136 \$00		
SOLUTION SOL		
SOLV1390 SOLV1390 SOLV1390 SOLV1400 SOL	F (485 UP(11).LE, ESS) DATIOO.	
\$00411300 \$00411	F (ASSUDXII).LE.ESS) DVIII.00.  PRAKIJ DO. II.  PRAKIJ DVIII.  PRAKIJ	
2011/100 2011/1	F   ASS   DZ	
SOLUTION SOL		
2011130 201130 2011		
SOLVIAGO SOL		
2011150 201		
2011150 201150 2011		
20011150 201150 201	0.0.4o.  vol 1.00   1.00	
2004 30 2004 30 200		
20011500 20115	## (  # DO     - S   F   # DO	
200   10   200   2		
20011550 20115		
2004 10 20 20 20 20 20 20 20 20 20 20 20 20 20		
20411550 204115	F MSS(MAXII). (E.EPS) AA(1):00 R MSS(MAXIII). (E.EPS) AA(1):00 R MSS(MAXIII). (E.EPS) AA(1):	
2004 100 200 200 200 200 200 200 200 200 200		
20411550 20411570 204115	r masickriii.cc.55, 4x4(ii.ec. 1856.4x4(ii.ec.55) Avatiiso. 18.ec.5, Appgilistuk(i)**62*2ak(i)**e2-872*av4(i)**e2	
2004 10 2004 10 2005 10 2006 10 200		
2004 10 20 20 20 20 20 20 20 20 20 20 20 20 20		
2005 2006 2006 2006 2006 2006 2006 2006	(1) 2 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	
2006 30 2006 30 2006 10 2007 1	TO AT AT 31 SORDING STREET, BASINGS BASINGS BASINGS	066 4406
2009 10 2009 10 200110	PROPERTY APPLICATION OF THE STREET STREET STREET STREET	909 4404
2006 30 2006 30 2007 160 2007	1	019 day
2005 20 20 20 20 20 20 20 20 20 20 20 20 20	F (ABS(RPM2([1)), LE, EP2) HPM2([) =0.	508P 620
SOLVIES SOLVIE	DE-5081 (ABS (BP42(1)))	508P 630
2005 30 50 50 50 50 50 50 50 50 50 50 50 50 50	F (RPM.LE.EPS) RPN=0.	508P 640
SOLVIGO SOLVIG	DESCRIPTION (1)	508P 650
\$504.1650 \$504.1650 \$504.1670 \$504.1	(1)=0.	508P 660
SOLVIGED SOLVIGED SOLVIGED SORP 10 SORP 20 SORP 20	NOM=-DX([) + YMX([) + 8T2+D2([) + AYM([)	508P 670
SOLVIANTO SOLVIANTO SORP 10 SORP 30 SORP 30	740MaD ([] + * AX ([]	50AP 680
SORP 10 20 SORP 30 SOR	F (FWUM.EG. G AND, DNOW, EG. 6.1 GO TO 10	069 ANOS
50RP 10 50RP 10 50RP 20 50RP 30	TOTAL SECTIONS OF SOME CARREST SECTIONS OF SOURCE S	2000
508P 10 508P 20 508P 30	「アフアコ・エング・レング・ロード・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・・	OL MADS
SORP 10 SORP 20 SORP 20	T (U(1) - EU(0) - F (1) - F (1) - S (04 (1) - C 0. F (1) - 1	500 TSS
SORP 10 SORP 20 SORP 30	( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )	2000
SORP 20	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	200
SORP 30	10111111111111111111111111111111111111	067 7506
05 2005		000
9000	10 10 10 10 10 10 10 10 10 10 10 10 10 1	077 4405
04 000	10 1 20 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0	100
04 000	OF CA CO REGULAR CONTRACTOR CONTRACTOR	001 4000
00 000	DOT OF ON THE PROPERTY OF THE	228 4806
04 0005		018 4000
8	Control of the Contro	078 4106
A SUBSINA SUBSINA SUBSINA SUBSINA	TO TOP TO THE TOP TO T	000
		200
000 000 000 000 000 000 000 000 000 00	00 01 01 02 02 03 03 03 03 03 03 03 03 03 03 03 03 03	000 4400
011 0802	•	200
041 9902		0.00
AL SUBSON-SUPERS	6.11.00	5088 e80
091 6805	101 01 09	000 000
021 0000		
000		014 4100
6		026 4005

Figure A-1(gg)

15 S	\$108 715 FORMATILISASJHOOEFFICIENTS OF POLYNOMIALS DESCRIBING EACH SECTION/STOP 12147745ECT10N-S4.2MC1.84.2MC2.84.2MC3.87.2MC4.44.2MC5.87.2MC5.684.2MC8.63.	STOR 530 STOR 540 STUR 550	7986	SCOEF (1-1C+A)-SCOFJ(1-1C) NONTHEMCOUNT-1 CONTINE	\$1081270 \$1081280 \$7041240 \$1081300
79.7	JOS GOMBATI///ISTA-1034570-E STAPES AS CALCULATED FROM THE INPUT POLYMOSTOR TANDAM STABLE DE COLLEGES AND DOLLES TO MEDRESSETTING THE/2018.	5108 570 580 5012	Ų		57091310 57091320
~ ~	SANSTONES - AND VALUES OF THE SOUNCE AND DOUBLET CONSTANTS!	STOR 590	U		STOR 1330
2:	ICCA ERKE STRPES)	570R 600		## (#COUNT .EQ. MST#S) 60 (0 10 #401TE (0.707)	\$1081360 \$1081350
: :	MASTONE WO. 13.64.22MHOSE TIP SHOCK ANGLE #.F7.3.	STOR 620		510P 707	57081360
22.	446LE 2+F10.31	STOR 640	، ن ر	LOCATE STORES IN WING COORDINATE SYSTEM	STOP1380
12.	IN STOWE SHAPE NO 15	STOR 650	ם יי	COM1 [ WUS	STOR 1 390
• •	*12****** OPTION	STOR 670			570R1+10
ž		STOR 680 STOR 690		7 TY 610 0.03 YYE-YY	57 CR1430
		STOR 700		[4]	510R1440 510R1450
	BEAD IN AND MOITE STORE GEOMETRY	STOR 720			STOR1460
		STOR 736	~		57081470 57081480
		\$100 750		16 (vy-v(1)) 12	STOR1490
		STOR 760 STOR 176	2		\$1041500 STOR1510
		ST09 780		[D] NSZ# (D) OS#Z	STOR1520
_	THE STANSACT OF THE STANSACT	STOR 790	•	GO TO 11	S1081530
	(7) BINGS (7) 30 (7) 15 (7)	STOR 810			\$10P1550
~	CONT [WJE NGOUNT #D	STOR 830		7850(C) 8758(J)	ST041570
	SEAS THE DOINT DATA DESCRIBING STORF SHAPE	STOR 840 STOR 850	=	Z=50(J)=Z5N(J)-ZPC(JLEM)-FWAC=(ZPC(JLE)-ZPC(JLEM)) - CONTINUE	ST041580
		S109 860			ST081600
	READ (5-701) NSMPT	STOR 878	. ب	CALCULATE SOURCE AND DOUBLE: DISTRIBUTIONS FOR ALL STUMES	STOR1620
	HAPE (J) . MSOR.STMS-M	5109 890		REWIND 11	51081830
		STOR 918		IF (MSMAPELISMP).LE.50) 60 TO 100	ST081650
	CIRCULAR STORE SHAPE DATA	STOR 920		CALL FRSTAT (11.2.LASTA)	51001660
		STOR 940	0	3nal Land	STOR1680
	READ(5, 70 - NSPOLU	STOR 950	Ų	1214 × 0	51041760
		STOR 970			STOR1 710
3	PEAD (5. ) (SCOFJ(K-L)-L=1-7)	STOR 980		IF (NSMAPE(R), NE, ASMAPE(ISMP)) GO TO 120	STOR1720 STOR1730
3	DO SI RELANSPOLL  BRITE (6-714) K-SENDJIK)	STOR 1 800		519CR(R) = 51C(R) = 010R==1CR	ST0R1740
	WAITE (6.715)	STOR1018		SPWIDD(K) H SDRIB (K) + OTOR	51081750
25	٠١١٠١٠١٠)	STOR 1030		HRITE (6.719) NUMSTRIK)	STOR1770
		57041040		IF (MSMAPE(4),67.50) GO TO 110	57041760
. ن د	READ ADDITIONAL GEOMETRY INPUT REQUIRED FOR MONCIRCULAR STORE	STOR 1060	ں ر	USE LIME SOUNCE/DOUBLET METHOD	57041600
ں ں		\$10R1680		MABOD**NS50R(X)+]	STORIAZO
S	CONTINUE STANDER IN	STOR1090		CALL 907GEN-0x80007-5844x(x)-5LTMC(x)-45POLY(x)-5XENU(1-x)-1-x-2008x(1-x)-4-54555000x(1-x)-4-54555000x(1-x)-4-54555000x(1-x)-4-54555000x(1-x)-4-54555000x(1-x)-4-545000x(1-x)-4-545000x(1-x)-4-55000x(1-x)-4-55000x(	S1041830
		57041110		2 SAASE (K) SSUMK (K) SSUMKD (K) )	51081850
	CALL GEOM Cali FASTAT (110) LASTA)	STOR1120		#505##7800V*-1 #550@(*)##50A	STOR1860
	SERVING STATE OF STAT	STOR1140	ں ں	FIND STORE SHOULDER LOCATION	STOR1880 STOR1890
,		STOR1160	U	B 0 0 1 1 1 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1	51091900
<b>3</b>	DO 68 KELINSTRS	STOR1180		IN (SOMERIMAN). LE. 0.0) GO TO 106	STOR1920
	IF (MSMAPFIL) "NE"LSTAPFIX) GO TO GO Strengiz) estistr	STOR1 200			S1081940
	IF (NSMAPEIR).61.50) GO TO 66	51081210		SRS-HLD(R) a SRL(NeR)	ST081950 ST081960
	MSPOLY(A) = MSPOLU	STOR1230	, , ,	CALCULATE SMOCK WAVE SMAPES FOR STORE-K	51081910
	DO 62 1=1.MSPOLJ SREMD(1.K) *SANDU(1)	57091250		##PITE (6.717)	\$100190
	DO 62 [C=1.7	51081200			21046688

	PTNOSF #TAN ( 190 , D-STHSMK) #DTOR ;	5102-010	BEADIN-106) CER-SSPEN	Sen6 270
	MENTING (BOTTES) NITESTATESTATES AND THE COMPANIES OF THE	\$10K2030	こう・ことのこうに ひょうしゅう こうしゅう こう こうしゅう こう こうしゅう こう こう こう こう こうしゅう こう	
	THE STATE OF	STUR-2040	MOMON CANCER SERVICE	
	Z-50-52-5-5-5-5-5-5-5-5-5-5-5-5-5-5-5-5-5	STUM-2050	#5#p##5#+1	
	60 10 120	510H20h0		
u		STC#2070	11 Jr #C.C. 1. V.	
U	USE SOURCE PANEL METHOD FOR STORE SOLUTION	21042080	SET IN CONTROL OF THE PROPERTY	345 3485
J	RESTORE STORE CONFIGURATION GEOMETHY	2104040	01007-1-7 CC	
٠ د	GENERALE STONE SHOLK SHARE AT ALPHANTHINES.	010013	TO THE CALL OF THE	
٠.				
110	ALPCIA H TABOTA	C1002130	SET LOGICAL MADIABLE	
	CALL VELCENCY CONTRACTOR	STORES C		
	1 (1518,61,1) 60 10 113		ZOIMED#.TRUE.	
	0.00	S10H2160	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
		51082170	14 IF (PHID (J) NE. 0.0) ZDIHEDK.FALSE.	
,	CALL SULVE (1504)	STOR2180 C		Sura seo
د د	COLUMN CATACA TA ACCURATO TO AF CYMMETRIF PIGHT-TO-1FFT + 10P-10-807		INPLT TWIST AND CAMBER DISTRIBUTION, IF ANY.	
		ST0R2200		SENG +60
,	1017E (4.73A)	ST0R2210	DO 15 Jr1-NPANLS	
	MOTTE (6.720) STROM	S10R2220	15 ALPHAL (J)=0.0	
	0.0 H 0.0	ST0R2230	READ (5,701) NTAC,NUNI	
	G H Z	ST0R2240	IF (NTAC .EG. 0) GO TO 19	
	00 112 Jal. WFUS	ST0R2250	WUNI .NE. 01 GO TO	
	NFUSX = NFORX(J)	ST0R2260	AN HO	
	DO 112 [=1.NFU5x	ST042270	DO 16 CHECHANDANESONCE	Swh6 530
		ST0R2260		
112	RMAX(K) = AMAX1(SRMAX(K)	51082290	16 READ (5.706) (ALPIAL(J).JeJNE-MN)	
	CALL BSHOCK (SRMAX(K), 90.0 SHKANG(K))	S10H2300	60 TO 19	2000
J		51082310	MAN	
، ن		01525012H		SENG SON
ٔ		51082340	FUN ( # 4 % CO	
î	ALTAC M ALTACATO	57082350	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
	TAIL OF LICE (ICTO)	ST0R2360		
		ST0R2370	19 CONTINUE	
ں ر	SAVE GEOMETRY. STRENGTHS AND AERODYNAMIC MATRICES ON TAPE10	ST0R2380	RE TURN	SENG 640
U		ST0R2390	END	SWN6 650
	CALL FRSTRT (10.3.LASTA)	STOREGO		
120	CONTINUE	STORC410		
130	CONT I MUE	51082420		
	SETURN.	51082440	Subbourting that vi	1 1441
	EMD			THK! 20
			SUBPOSITING TO LAY DUT MING AND PYRON THICKNESS PANELS	THKL 30
		<u>ں</u> د		
			SOMEON SERVICE	
	and the state of t		COMMON/CONSTS/P1-P12-D10R-R10D-F00HP1	
		54N6 20	CORROLL NO TENENT SERVICE STORE AND SERVICE SE	1mm
	THE THORT OF	SwN6 30	10100.00.10.00.00.00101	
٠,	STATEMENT OF THE		COMMON/PYGE CM/2 (20) *APLE *YPL *CRF *MP *PSIPLE (20) *PSIPIE (20) *IP *	THKL 90
. ر		SWN6 50	1 SLLE + PSLPINF + CENTEM + 2PL + LYSPP	Ĩ¥,
,	106174 201460		COMMINATERNOAL/NOBS-NOBS-MINS-MINS-MINS-MIND-MINT (#00)-MINT (#00)	
	COMPON/CAMBER/ALPMAL (200)		1 KLFT(&00).*KLFT(&60).**FCT(*C0).**KCT(*00).*2*CT(*00).*2LCT(*00).*	1
		SENG	2 THETAL (400 - THE TPL (200) - SLLET (400) - SLTET (400) +020x (400) .	Ĭ
	COMMON/INDEX/NCM+MSH+MSHP+NPANLS+NCMB+NBOCRI+NBOCR2+NBU+NBIP+MP+	SENG	3 VS.1201-PSESEE (201-PSESEE (201-PSESEE (201-	-
	1 NCP. MSP. V1P. N2. N2P. NPTOT		* ************************************	
	COMMON /#GEOM / XSWOC+2840+CRM+SLPMLE+SLPWTE+PSIMLE(20)+	SENG 110	**************************************	
	20) • Y (20) • PH]		TANDON TO COURT OF THE COURT OF	É
20	701 FORMAT(1015)			ĺ
č	706 FORMAT(8F)0.0)		2 SNPH (200) + CSPH (200)	Ĭ
	DARS DARS TO THE TERMINATION OF	100		
700	FORMAT (15.4F10.5)		LAY OUT THICKNESS PANELS ON LEFT WING PANEL	
705	FORMATI//JAK.14. 56H U-VELOCITY PANELS ARE TO BE LAID OUT ON EAC	90		
	INING PANEL/20x+13.20# CHOPOWISE ROWS BITM+13412# IN EACH ROW/)	28.00	2 - B. J. C. J. J. C. J.	Tuffi 260
106	- FORMAT (15% - 504 SPANATSE LOCATIONS OF PANEL SIDE EDGES AND SAFET -	ON A S	STEERS OF STEERS	
	THE SMOOTCH STATE TO THE TABLE SO THE SOUTH STATE TO THE	S#NG 220	0.69=0.375	THE 270
	3 20%.1M1.5%.8MLOCATION/28%.4MFEET.5%.7MDEGHEES.3%.7MDEGREES.3%.	SWN6 230	ANCHINCHS	
	4 PHOEGREES!	2		
707	7070 FORMAT(18X+13+4X+4F10-5)	SENG 250 C	COOP DARM CHOMBAINE MORN OF THICKNEYS PANELS	THE 300
J				

Figure A-1(jj)

2LCT(J) #2ER+ (SNP/CSP) \*0Y 130 CONTINUE CSIDEP#CSIDE 140 CONTINUE

PLEXENPLE | HOLSTIP=2)\*NC#\*1 | FKIP=GT.1) PLEXENPLE\*RLF(19Ox) ANCP#NCPS

IFINDY.EG.O! WETUNN CSIDEP=CRP

150

22.25.(M) -25.(1) 91.66.21) 60.10, 201 15.(1.60.21) 60.10, 201 15.(1.60.21) 60.10, 201 15.(1.60.21) 60.10, 201 201.00

00 250 KH1+NCPS JH(I-2)+NCPS+K+4S AMMH-1 AMH

AMANK-1 SLLET(J) SLPHLE-AKM-SLPDJF/ANCH SLTET(J) SLPHLE-AK-SLPDJF/ANCH SLPHS(J) RSAP SWPHS(J) RSAP

DO 130 K#1.MC#5 J#(I-2)\*MC#5\*K AK#K

. . .

CORNER POINT COOPDINATES

000

#51=#5#5.1 00 100 1=2-#51 1=1=1

	THE SAY		**************************************	360 6111
37 020x(1) = TML 1AL (1) / 71	1HAU 510		•	
	14FC 560	ں ب	THE COURT OF DEALER AND THE TO A STATE OF STATE OF THE ST	VE. 7 750
		Ų		
			Z/102/1// ) 12/102/12/12/102/12/12/12/12/12/12/12/12/12/12/12/12/12	
(CE - AA - ER - (CG - ST - ST EE - CCC - C	vera li		כשוו הניסו וענונש)	
	-		[f 1.NO'.FELTAI 60 TO 11	
	VE 18 30	ب ب	1 451 XX OF 1 10 451 164 101 1 30 4515 1514 1	2/2 9734
			-315.6 21 17 20132 21 2 20 2015	
DATEGRACE FORME	ver6 60		0-20	
				WELD BACK
EOM/SNTZ(200)+CSTZ(200)+2LC(200)+2MC(200)+1M11(200)+				VELB 830
		٠,	ROTATE VB. WB IN SYSTEM 2 INTO V. W IN SYSTEM 1	3 -9 6-5
PANLS.NCBB.N6OCRI.NBDCP2.NBD.NHIP.MP.				VEL 8 650
1 NCP. #SP.*NIP.*N2.N2P.*NPTOT	vf.18 130		での10mmの10mmである。 でいまま マン・ロー・ロー・ロー・ロー・ロー・ロー・ロー・ロー・ロー・ロー・ロー・ロー・ロー・	000 B134
COMMON/WF0CE DM/XMF 12001 *XXH 12001 *XCF 12001 *XMPLE (2001 *S#PTE (2001 *VELD * VICE)	VEL 8 100		10+10+0	*ELB 860
> SNP41(200) • CSPH1(200)	vere 150		>->==>================================	969 9134
COMMON /VELARS/X+Y+Z+U+V+#+EM-TLANC+TIPY+PYPNL	VELS 150			019 6134
OCCAL DOVON SEELTA. SELTAL SEELTB. SEELTB.	VELB 180			
	VELB 390	٠,	INFLUENCE OF CORNER 1 ON MATCHING PANEL OF RIGHT BING	VELB 430
THERE ARE THO COORDINATE SYSTEMS IN USE IN THIS SUBJUCTIVE	VEL6 210		YME-(YI-YLC(1))	364 9134
	VELB 220	J		
X+U POSITIVE FORMARD	VELH 230	Ų,	TRANSFORM TH. ZW IN SYSTEM 1 TO T. Z. IN SYSTEM 2	VELB 970
IVE TO RIGHT	VELB 240			
E DOWN	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		グレラコペーネジャラトド	04 B 000
ERTEN OF INFLUENCING SEMI-INFINITE TRIANGLE	SELB 670		141	VELBIDID
	VELB 280		: F ( . MOT . F ELTA ! ) GO TO 10	vf.81020
E BACK	VELB 290			VE 181030
E CLOCKEISE LOCKING FUNDAND. IN FLAME OF	VELB 310	. ر	ME TOWN O TO STOLEM I	05014132
WE DUTHARD NORMAL TO INFLUENCING PANEL	VELB 320		U-=U	v£.81660
	VELB 330		A-8-A	ver.01670
INFLUENCE COEFFICIENTS JP. VP. #P APE IN SYSTEM 1	VELB 340			VELR1080
	ver 6 350	, .	THE SANGE OF STATE OF	*E.B.100
150 m 2 c 2 c 2 c 2 c 2 c 2 c 2 c 2 c 2 c 2				ve. 81110
			VRVHOCS-EB-SN	VEL61120
	VELE 390		E-KBeCk-EBeCK	v6.18130
			>1>	VELE1150
	VELB 420		Tes Tes t	VELBIIGO
6	VELB 430		FELTE.TRUE.	VELB1170
SMAKE CANTON SAT NO SOUTH SAT AS TO	VEL 8 450			VEL61190
		J	CORNER 1 EQUATIONS FOR PANELS IN UPPER LEFT QUADRANT	VEL 61200
		u		vere1210
	4	<u>.</u>		VEL 61230
C2=C3-C1=C3-C2=C2-C3-C2-C3-C2-C3-C3-C3-C3-C3-C3-C3-C3-C3-C3-C3-C3-C3-		_	ZW#71-2LC(1)	VELP1240
		_	ARABOCS-SEESING	v6161250
	VELB 520		Z=ARoSN=ZReCZ	46161260
D • C	VELB 540		Call VELO) (FELTa)	VEL 81280
0 0	VELB 550		1F (.NOT.FELTA) 60 TO 16	VEL 61290
IND.THTITK1.LE.180.11 GO TO 15	VELB 560		חח	VELP1300
	VELB 5/1			VELR1310
	VELB 590		ALCOURT CO. MICH.	v£1.81330
	VELB 600		REVB-SH-HB-CS	v£ 1813.0
EDUATIONS FOR PANELS IN LOWER LEFT GUADRANT	VELB 610		3-1-2-1-3-1-3-1-3-1-3-1-3-1-3-1-3-1-3-1-	VELH1350
	VELB 630		N-10-10-10-10-10-10-10-10-10-10-10-10-10-	vf.61370
I IS IN SYSTEM 2			FELTE, TRUE.	vf.61380
	VELE 610	=	このこのコンプトリー・スプロスペッグにもまたす。	046 19134 AF 1 9 1 9 0
ABALT CINEAL		_		

Figure A-1(kk)

\$3#Z-M5#A#Z	VELB1-10	CALL WELD1 (FELT91)	******
78-7 78-1 - 25-01-466-787	VEL 81 4 20	17 (.MOI.PELIMI) 60 10 25	46.2.49
IF(.WOT.FELTA;) 60 10 17	VELBIAAO	* i = 1	******
7-27	VEL. 81450		*EL32190
>==8>	VELB1.50	Zue par Cue and	v£L82200
	VEL 6 10		vELB2210
	VEL 61 490	77	VEL 62220
	VEL R1500		VELB2230
) > - 	VELB1510	FELT . TAUE.	161 B2250
7-2102		25 IF(.MOT.FELT) GO TO. 40	V£L82260
Ë			*ELB2270
60 10 17	VELB1540 C		**************************************
	,	20 15 (x1) .56 . 11 .0 (1) .0 10 40	**************************************
IN LOWER LEFT GUADHANT		## ( T M 1	WELBC300
			vELB2320
IN-CIP SERVICE COLUMN TO THE C	VELB1590 C	CORNER 3 EDUATIONS FOR PAVELS IN THE LOWER LEFT QUACHANT	VEL82330
			v£L82340
	VELBIBIO		VELB2350
NU SECTION AND AND AND AND AND AND AND AND AND AN	VF1 R14 30	Z=21-ZL((1)	VELBE300
CALL VELOI(FELTB)	VEL 81640	ARAMACZ-SZ-RAZN	VE. 92380
IF (.NOT. FELTR) 60 10 12	VELB1650	Z=##eSM=Z#eCS	VELB2390
0-=0	VELB1660	CALL VELO1(FELTA)	VEL82400
>= @ :	VEL01670	IF (.NOT.FELTA) 60 TO 23	VELB2410
アントライン	VELB1630		VEL82420
いい・のフェースパッピン・ロフ	VEL 81 700		76182430
Tu=U1	VELB1710	NS-83-SO-6AHA	VF1 B2450
A->L=>L	VEL81720	EXCHASULEBOOK	VEL82460
2-2-42	VELB1730	tu=tu-u	VEL82470
felts, raue,	VELB1740	>-XL*XL	VELBZ480
COLUMN AND AND AND AND AND AND AND AND AND AN			VELBZ490
というさ~ いこうかん はんしょう こうかん はんしょう こうかん はんしょう こうかん はんしょう こうかん しゅうかん しゅうしゅう しゅう		23 YW=-(VI)**(C(I))	VELB2500
CD-07-176.003	VELB1770		VELB2510
TEC.NOT.FELTER 60 :0 13	VF: 81790	C):27.75.01:27.	VELB2520
0-40	VELB1800	IF (.NOT.FELTA!) GO TO 30	VELB2330
>= @>	vEL81610	ח-בח	VEL#2550
	VELB1820	>=0>	VEL82560
	VELB1830		vEL 92570
ליים ביים ביים ביים ביים ביים ביים ביים	VEL RIASO	グローのラーのファイントラントのファイントラントのファイントラントラントラントラントラントラントラントラントラントラントラントラントラン	VELBES00
7×=1××	VELB1860	Tu=Tu-u	VEL #2600
	VELB1870	> > > 10 × 10 × 10 × 10 × 10 × 10 × 10 ×	VELB2610
FELT= TRUE.	VELB1880	7-3-03-	vEL82620
13 [F(_NOT_PELT) GO TO .0		60 10 30	VELB2630
	VEL 81910	CORNER 1 FOURTIONS FOR PANELS IN LIBER LEFT DUADANT	05456130
JAMER 2 EQUATIONS FOR PANELS IN THE UPPER LEFT QUADRANT			VFL BZAAD
		19 x=x[8(1)-x]	VELB2670
	VELB1940	(1)	VELB2688
7687 207 117	VELB1950	(1)37-17mm	VELB2690
250 22 0 CO 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	VEL 81970	グレラスペースプラストリン	00/2873A
ZHANSAN-ZHOCS	VELB1960	Att	VELB2720
A== A	VELB1990		vEL82730
CALL VELOI(FELTB)	VEL 82000	IF (.NOT.FRLTA) GO TO 26	VELB2740
	VELBZOZO	> I I I I I I I I I I I I I I I I I I I	VEL 82780
>-= @>	VELB2030	20世紀20日	VEL 82770
	VEL82040	ZV+GE+SU-GE+	VELB2780
VI THE ALL DEPTH A	VEL 82050		VEL82790
Tuartier	VEL 82070	A-ALHAL	VEL 82810
->L4AL			WEL 82820
		\	VEL 82830
24 YM=-(YQC(1)+Y1)	VELB2110	SP#Sewser S	VEL 02050
ZS+2X+SD+2X+Z	VEL82120		VELB2860
	VEL 62130	CALL VELVELVELIAL)	VEL 82870

Figure A-1(mm)

....

The same of the same of

Figure A-1(nn)

CHECK FUR CHAMFOT LEBOING EDGE FIRMSIEM, HITTERMCH GO TO *0 TYEOGERT-KYEM,		ver01160 ver01160 ver01210 ver01210 ver0120
	550 510 520 530 540 550 550	VELO129 VELO129 VELO129 VELO129 VELO1290 VELO1290
DETENTINE WHETHER DOINT LIES INSIDE MACH COME FROW OPTICING IT ILLES OUTSIDE, SET PENTURRATION VELOCITIES TO ZERO.  IF ILLES OUTSIDE: 60 TO 3  INSIDE COME FROM OPTICING.  INSIDE COME FROM OPTICING.  INSIDE COME FROM OPTICING.	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-
		08161%.
OFFERSING WITH LEADING COST  OFFERSING WITHER POINT LIES INSITE MACH COME FROM ORIGIN.  TO OUTSING TO LEADING EDGE SET U.V.W.W.TO ZEGO.  IF LANDILMSIDS OF LEADING EDGE SET U.V.W.W.TO ZEGO.  IF LANDILMSIDS OF LEADING LOUE SET U.V.W.W.TO ZEGO.  IF LANDILMSIDS OF DEADING LOUE SET U.V.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.W.		VELO13-6 VEL
GO TO 100  DETERMINE WHETHER POINT LIES INSIDE MACH CONE FROM ORIGIN.  JE OUTSIDE THERE IS ONE WORE CHECK TO MAKE.  JO IF (1951DE) GO TO 35  POINT IS OUTCIPE MCH CONE FROM ORIGIN.  DETERMINE IF IT IS INSIDE CONE FROM LEADING EDGE  JE OUTSIDE. SET PERIORRATION VELOCITIES TO ZERO.  JE OUTSIDE. SET PERIORRATION VELOCITIES TO ZERO.	2001) 2010	VEC01089
CONTRACTOR CONE FROM LEADING EDGE	<b>.</b> .	VELO1860 VELO1960 VELO1960

Figure A-1(00)

Figure A-1(pp)

Figure A-1(ag)

0.70.70	
	069
COMMER 1 FOR EM1 .LT. 0 PANEL LEADING EDGE SWEPT FORMARD	700 C COOMEO 3 GOO CH3 CF A CAMES 2011 110 FOOT
15 CONTINUE	ں ر
	710
	VELP 740 FIRETO
F101×	2002
2**21*ZLC(f)	0.70
CALL VELOTIFIED AND TO SP	VELP 780 CALL VELDIFELTA
	800 TU#TU*U
7.57C#7	
	920
52 IF (CENTER) 60 TO 17	VELP 840 YEVING 10 30
7±7 [#6	850
CALL VELOI(FELTAI)	90
TENTON CONTRACTOR OF TO IN	VELP 670 TURIOUS
A+21=21	
第一条	90
60 10 17	WELP 910 C VELP 920 C CORMER 3 FOR FM2 .LT. 0 PANEL TRAILING FOOF SWFPT FORMADO
	3 OF
	61 04
CORNER 2 FOR FM1 .GE . 0	VELY 450
	4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
10 CONTINUE	
	CALL VELOI (FELTA)
X10240	
CALL VELOTIFELTS)	V-F-10-10-10-10-10-10-10-10-10-10-10-10-10-
IF (.NOT.FELTB) 30 TO 12	
7.25.07	VELDIA-0 53 F (CENTER) 60 TO 21
第十字 にゅうし	
	VELP1070 IF (.NOT.FELTA) GO TO 21
12 IF (CENTER) GO TO 13	TU=TU=U
787 [30] (55) 731)	
[F(.NOT.FELTB1)60 TO 13	
1∪±1∪+U	v
7-7-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	
	7
13 IFI.NOT.FELT) GO TO 40	ں ر
60 10 20	90
CORNER 2 FOR EM1 .LT. 0	
17 CONTINUE	
	VECFAZIO CAL VECATIFICATO TO SE
447018	TU#TU#1
2=-21-24C(I)	
CALL VELOITEEFER	
[P(_NO)_PELIB) GU (O   B	VELP1260 35 IF (CENTER) GO TO 40
	VELP1200 IF (.NOT.FELTRI) 60 TO AD
FELTS, TRUE,	TU=TU-U
מו בינוניים בינונים בינונ	
CALL VELOTOFELTBY	
IF (.NOT. FELTBI) 60 TO 15	U
3.75	VELP1350 C CORNER 4 FOR EMP .LT. 0
# 1 # 1 # 1 # 1 # 1 # 1 # 1 # 1 # 1 # 1	
FELT#.TAUE.	;
14 161 MOT FELT 1 GO TO AD	
20 00 00 00 00 00 00 00 00 00 00 00 00 0	VELP1390 V=V018

Figure A-1(ss)

CORVER 2 FOR EM1 .LT. 0	VELP1180	gluan.	VELP1920
	761 0170	101 101 101 101 101 101 101 101 101 101	V6. P. 94.0
AB-41-ADFT()	VELP1210	TF (.NOT.FELTB) 60 TO 35	vELP1950
	VELP1220		VELP1960
Z=-21-24C1(1)	VELP1230	7-7-187	VELP 1970
;		Tearline Management	VELP 1980
• 7	VELP1260		VELP 2000
	VELP1270	CALL VELOTI (FELTH)	VELP2010
	VELP1280	[F(.NOT.FELT9]) GO TO 40	VELP2023
7EL13, 1805.	VELP 300	2171471 247471	VEL P2040
Dallar.	VELP1310		VELP2050
FLOT1 (FeLTH)		60 TO 40	VELP2060
			VELP2010
	VELP1350 C	בעל ירוי	VELP2090
	VELP1360 21		VEL P 2100
			VELP2110
10 100	VELP1380	1**10[2	VELP2120
	00 4 L D 1 4 0 0	Z==Z1-Z#C111)	VELP2130
	VELPIOLO	TRE VELOTIFICATION OF TO 28	VF1 P2150
3 GO TO 19	VELP1420		VELP2160
	VELP1430	1/21/·V	VELP2170
CONNET STORES SEE OF THE PARKE INSTITUTE COSE SECTIONS	VELP1450 29	THE THREE SO TO SO	VELP 2180
		**************************************	VELP2200
Enturence Control of the Control of	JELP1470	(FELTB1)	VELP2210
און און יאר אין און אין אין אין אין אין אין אין אין אין אי	0641413	IF(.NOT.FELTBI) GO TO 40	VELP 6220
Z*Z1-ZLCT(1)	VELP1500	O+0-+0-	VELP2240
FELTA			VELP2250
IF(.NOT.FELTA) 60 TO 23			VELP2260
D*D   PO   PO   PO   PO   PO   PO   PO   P	VELP1540 C	SIGN CHANCES MECESSARY TO ACCOMPOSEL USE OF SUBMOCTINE VELOTH WITH DIFFERENT COORDINATE SYSTEM	VELP2280
7-2-11	u		VELP2290
23 IF (CENTER) GO TO 30	VELP1560 40	_	VELP2309
	VELP1580		VELP2320
FELTA1) GO TO 30			VELP2330
	VELP1600 C	CALCULATION OF PERTURBATION VELOCITIES	VELP2340
		The County of th	VELPC350
	VELP1630	(1) (0) (0) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	VELP2370
			VELP2380
C CORNER 3 FOR EMP .LT.O PANEL TRAILING EDGE SEEPT FORERD	VELP1650 100	CONTINUE	VELP2390
19 Emt = - Em 2	VELP 1670		VELP2410
FIXI.6E.ALBTI11 GO TO 40	VELP1680		
	VELP 1590		
	VELP 1710		
;		SUBROUTINE VELUPICAT.VV.22)	
9.7 0.1		OT SING SIMPLIFIED 9	
		WING CONSTANT U VELOCITY PANEL AT THE CONTROL POINT OF ANOTHER	vEL# 40
		CONSTANT U VELOCITY PANEL	
70 IF CRAIRS 60 10 71	VELP1780 C	SCHOOLINGS OF A CORPER SOLUTIONS IN USED IN THE MINE	VEL 8 00
LOTI(FELTAI)			
		SMS. (AAC) THE LAAC) THE LOCAL TIES (AAC) CHACLETHE MORROR CHACL	
	VELP1820	COMMON/15VEL/UP.VP.WP.11.1F. OELTP(200)	
Terral and the second	VELP 1830	COMMON /#GFOM/XBMOC.28WO.CHW.SLPHIE.SLPHIE.PSIMIE (20).PSIMIE (20).	
	VELP1850	**************************************	
Consesses estates of CONTRO 6 sees sees sees sees sees sees sees s	** VELP1860	1 *LC(2001-xCPT(2001-YCPT(2001-2CPT(2001-5mPPLE(2001-5mPPTE(2001	
CORMED . FOR FM? .GE. D	VELP 1880	COMPAIL (2001-105FHI (2001	VEL 170
	VELP1890 C		
30 CONTINUE	VELP 1900	LOGICAL PYPNL.FELT.FELTA.FELTAI.FELTB.FELTBI.ZOIMED	

Figure A-1 (uu)

**.** . . .

		9		26.45.419.
	3.00		JF(K], GE, NPB(I)) GO TO 40	VEL-2460
	FELT=.TAUE.	VEL WITTO		VEL = 2.050
~	TEV   - 4 AC C	VEL 11 7 20		NELEC. 60
		VEC #1750		76.67.0
		VELW1750	Z=-21-2LC(1)	VELW2490
		VEL # 1760	Z+=Z	VEL#2500
÷	CONTINUE	VELW1770	Year	VEL #2510
	CALL VELOSIFELTRES	VELW1780	1# (201 #E01 GO TO 102	VEL=2520
	IF (.MOT.FELTBI160 TO 13	VELWIROG	7**************************************	VEL#2540
		VELW1810 102		VEL #2550
	1F (2014E) GO TO MA		CALL VELOI (FELTA)	VEL #2560
	V=8071.44.84)	VELW1830	IF(.NOT.FELTA) GO TO 51	VELW2570
	(AR+AA)###	VELW1840	>> 1	VELUZSB0
2	COSTINUE	VEL #1860	IF(ZDIMED) GO TO 104	VELW2600
	7*2°=2°=	VEL MIBTO	(アニ・アテ) せいひはっ	VELWZB10
	3· 5- 13-			VELW2620
	FELT».TAUE.	VEL #1890 104	•	VEL #2630
2	13 IF(.WOT.FELT) GO TO 40	VELMISTO	D.O.I.O.	VEL #2650
		VELW1920	第 ・ 東 に 日 次 に	VEL W2660
ں ,	CORNER 2 FOR EM1 .LT. 0	VELW1930 51		VEL # 2670
		VELW1940	****	VELEZOSO
-1	17 CONTINUE	VEL #1950	11 (2014EU) 60 10 100 ***#8014C(**2)	261 1122
	[CW=2     CW=2	VELU 970	ZV=ROTBC(Y+Z)	VEL#2710
		VELW1980 106		VEL #2720
	Z=-21-2AC(1)	VEL # 1990	CALL VELOI (FELTAI)	VEL 12730
	Z=A2	VEL #2000	IF (.NOT.FELTAT) 60 TO 30	VELUE740
	:	VEL #2020	> 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	06/20124
	16 (20) *** 01 00 00 00 00 00 00 00 00 00 00 00 00	VEL W2030	1F (201MED) 60 TO 108	VELUE? 70
	74=00=34	VELM2040	•	VEL = 2760
8			WHIND BO (VV + HV)	VEL B2790
	CALL VELOTIFELTA:	VELW2060 108	I CONTINUE	VEL W 2606
	15 (. NOT. FELTB) GO TO 18	VELWZORO		0182810
		VEL #2090	3-3-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	VEL W2830
	15:2014ED: 60 10 42		60 10 30	VELWZBAO
	_			VELW2850
,		VELW2120 C	CORNER 3 FOR EM2 .LT. O PANEL TRAILING EDGE SWEPT FORMARD	v£tw2060
2			CONTINUE	VELEZARO
			100=3	VEL M2890
	P-21-01	VEL #2160	F(x1.6E.ALB(1)) 60 TO 40	006Z#73A
	FELT*, TRUE.	VELUZ170		VELUZ910
•		VEL W2198		15 L 0 C 0 C 0
	14 (20 10 40 10 44	VEL #2200	11.272-12-02	VEL W2040
	TYPROTALY.Z	VEL #2210	Z=A2	VEL #2950
		VELW2220	A 8 A A A	VEL #2960
\$		VEL 8224 0	1.12014EU GO 10 110	0/6/11/24
	\$ 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1			VEL 12990
	> -	VEL W2260 110	-	VEL # 3000
		VEL #2280	[ CALL VELOI * FLIA)	VEL #3011
	•	VEL 42290	Anna	VEL #3030
		VELUCION	Anan	VELUDOLO
•		VE.: W2320	VEROTACION SO LO LIZA	VEL#3050
	A-2422			VEL # 3070
		V(L52340 112	CONTINUE	VEL 10 30 80
•	# FELT = 1 40 E	VEL#2360	2-1-1-0-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-	VELWALDS
		VEL W2370		VELUSITO
•		**************************************	**************************************	VEL #3120
	20 15 (642 .1. 0.0) 60 10 19	VEL #2460	IF (701™ED) GO TO 11♠	VELWAINS
U		VEL W24 10	**************************************	VELW3150
U	CORNER ) FOR EM2 . GF . 0 PANEL THAILING EDUC SWEP! KACK	12.24.134	(7·4:9:0ha)	Acrasion

OLIEMINA	CETTAL OBJECT OF COLOR	21 VELW3190 JF (ZDJ-HED) 60 TO 132		VELBASON ASSOCIATION	VELW3230 TO#10+1	VELU3240 TVATV-V	VELW3250 THRTM+W	25 4	***	JF (201HED) GO TO 134	YVEROTA (Y.Z.)	2.1910837	STATEMENT ACT IN THE STATEMENT OF THE ST		1	VEL#3336 [F'.NO].FEL'8] 60 10 40	ALM330		IF(201MED) 60 TO 136	VEROTAC (VV+WV)	W=RDTBC (VV+WV)	136 CONTINUE	10m1ロ・ロ	10=10	VELW3420	VELETA 30	u	U	C RETURN INFLUENCE COEFFICIENTS	VELWEATO C SIGN CHANGES NECESSARY TO ACCOMDDATE USE OF SUBROUTINE	SS VELO WITH DIFFERENT COORDINATE SYSTEM	J	VELW3500 40 CONTINUE	VELN3510 UP=-TU VELN4	VF-1V VELNA		RETURN	END	V€L#3560	4EL43570	VELW3500	A CAR AND	ALLWAY SUBBOUTINE VELWII (AKINTA 22)	AND AS ASSUME SALESTED NOTIFICATION OF A CONTRACT OF A CON	VELVE OF THE PROPERTY OF THE P	ATIAN DISTO SI SMOLLINOS GENERALES DE PORTUNA A PORTUNA	OF OF THE PROPERTY OF THE PROP	#13A	VELNA COMMON VICKEL /UP. VP. VP. VP. VP. (200)	WIND THE PART TO COMPANY THE PART AND STATE AND STATE TO	1 XEFT(400).XEFT(400).YRCT(400).YLCT(400).ZRCT(400).ZLCT(400). VELW	2 THETAL (4001+THETPL (200)+SLLET (400)+SLTET (400)+DZDA(400)+	3 Y5(20)+PSHSLE(20)+PSHSTE(20)+PMIS(20)+25(20)+PSPSLE(20)+ VELW	4 PSPSTE(20)+SNPMS(400)+CSPMS(400)	COMMON/THVARG/X.VV.ZV.U.VV.WV.EML.PRT	COMMON /VELARG/DUNY 19) *PYPML	COMMON/#GEOM/XB#OC.28#0.CM#.SLP#LE.SLP#1E.PSI#LE (20).PSIMIE (20).	VELM3160 3 YYY120).PMID170).ZDIMED:WICA	VELW 3770 C	734	LOGICAL FELT-FELTA-FELTA-FELTB-FELTBI-PYPNL-7DIMED	A CAN SHOULD WITH A STANDARD OF STANDARD STANDAR	T STATEMENT TOTAL	TON VORTE (ATT) PLOG	AND	M13A M223-08-145-0-08-08-13-13-13-13-13-13-13-13-13-13-13-13-13-	ACCOUNTY BOOK AND ACCOUNTY BOO	NOTE TO SEE THE SEE TH	CELETARD PYDNL = FALSE.	VELENGO POPPLETALSE. VELENGO LUGANA UN VELEN VEL	VELWEGO PYPML = FALWEGO PYPML = FALWEGO
114 CONTINUE	CALL VELO3 (FELTA3)		7717	AMERICA CONTRACTOR OF THE PARTY	ATTOCKED OF THE		116 CONTINUE		747			12 01 09				CORNER 4 FOR EM2 .GE. D		30 CONTINUE	1CP=4	x==x2+x88+13	y=-Y[+YPC[]}	2=-71-78(1)	7247		1F (2014FD) GO TO 120	Variable (V. 2)	24-1010147	31111111111111111111111111111111111111		CALL VENULTELIEV	2	> 1	TECHNICAL CO TO 122	VARCE CALLED		122 CONTINUE		TVETV-V	第一次に 作用に	35 YEY1-VRC(1)	ARAL	1F (201MED) 60 TO 124	YV=BOTAC(Y.Z)		124 CONTINUE		2	>=>	•	IF (2014ED) 60 10 126		CANALIME OF COMPTHEE	Tri-Line	2 1 2 1 2 1	Tenter	50 TO 40		CORNED & FOR FW2 .LT. 0		21 CONTINUE		X=-X1+XRB(1)	Y=Y1-YAC(1)	Z=-Z1-ZBC(1)	Z= \ \ Z	A A A A A A A A A A A A A A A A A A A	IP (2017ED) 60 10 130	7041810884			130 COMTINUE CALL VELOI(FELTB)

Figure A-1(xx)

Figure A-1(yy)

46144030	VEL # 60 60	VEL #4050	VEL 44060	VELUA 370	AEL BADGE	75. 10.00	01147	VEL #4120	VF1.84130	VF1 #4 140	VEL 44   50	VF: 44160	VE: 44170	VEL #4160	VEL #4190	VEL #4.206	VEL W4210	VELMAZZO	VEL#4230	VELU4240	VEL#4250	VELUE 200	200734	VEL 44.290	VEL 84300				W078 10	WDV8 20	9 40 A		#DvB 64	WDV8 70	80v8 <b>6</b> 0	MOV8 90		WDY8 120	#0v8 130	MDVB 140	040	MOVE 170	#078 180	501 WDVB 190	4048 200	BOVE 210	MP=078 230	WDv8 240	DVB 250	#DYB 260	#DY8 270			SAQ.	9		40.4	6 V G	8048	#04B	#04B	9 Q 4
VELU3280 [F (20]MED) GO TO 134 VELU3280 VW-MODA(V.Z)		***VEL#3310 134	CALL VELOTI (FELTBI)	AFFERSO (1-147) CO. 10 40			VARALLE CANADA		136		_		ų		u	u	J	VELM3480 C VELOTH WITH DIFFERENT COOPDINATE SYSTEM	۰	3	VETERAL CONTOUR OF THE PROPERTY OF THE PROPERT		100		VELW3560 END	VELVE STORY	VEL MISSON			VELLOS C	ی ر	, ,		Ų	u				VELMATAS 3 REFA-REFO-PEFL-PEFX-PEFZ-CCTEST-1IMAX-800L-1Z1(12) BDY8 130							- TOTALON TOTAL OF THE PROPERTY TOTAL OF THE				SELECTION IN STREET CONTROL OF THE SELECTION OF THE SELEC			VELM3900 701 FORMAT(1015)		METHANSON A CARACTER OF THE TANK OF THE TA							
Twerw-m 60 to 21			;	0 - 30 - 40 - 40 - 40 - 40 - 40 - 40 - 4	10 COMPTMES		- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	**** 1 ** ACT ( ] )	Z=-21-28CT(1)	Zea?	****	1F (201MED) 60 TO 120	TVEROTAC (T.Z.)	2**BOTBC!**21	CONTINUE	CALL VELOTI (FELT9)	1F1.NOT.FELTB1 GO TO 35		1	14 (ZUIMEN) 60 10 122		CONTINUE	Tu=10-0	1×24×4		JS WEVIOURCT(II)	IF (2014ED) GD 10 124	TV=ROTAC(Y.Z)	2V=POTBC(T.2)	CONTINUE	IF (.MOT.FELTB) GO 10 40			IF (201MED) GO TO 126		CONTINUE	Tu=10-U	TV=TV-V			CORNER & FOR EM2 .LT. 0		CONTINUE		71-71-72-71-72-71-7-7-7-7-7-7-7-7-7-7-7-	Z=-71-2RCT(1)	2*^2	7. F.	17 (ZDIMED) 60 10 130	7**************************************	CONTINUE	CALL VELOTI (FELTB)	1F 1.NOT.FELTB) GO TO 28	> 1 1	IF (201MED) GO TO 132	?_	###QTBC(vv.ev)	CONTINUE	0.07407			(CI) LOGA-1A) - 8A 62

Figure A-1(aaa)

Figure A-1(bbb)

000

000

**.** . . .

**...**.

**...** 

**U** U U

1	: <u> </u>					9 0 0 0 7 7 F 6					
	1 5 7 7 7		181987	2222		1221		728 728 728 728 727 727 727	7.7.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4		
### 170 ### 170 ### 171 ### 172 ### 173 ### 17	A CONTRACTOR OF THE CONTRACTOR		СОММОМ REWIND B 118 = 1 DO 120 [Fusive'S NY Z = WOMRIFOUS MADDA(FU) IF INFUSE(1) (ALL 10PEAD (FU) CALL Y PREP (AFC (1AB - ALLYB) - ARADA(1FU) - MEDBA)) FU -	178		SURBOUTINE YZEIPZINH.*B.:P.:NHAD.*M.USON) QOUTINE TO PERCENT 'TE INITEDUATION IN THE BOUY GEOMETRY THE GOOD INITEGERS. GEORGE GEORGE GEOMETRY		SEC INI			
### ##################################	0000	9 6 9	000000000000000000000000000000000000000		8 2 2 2 E						~ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
### ##################################											1924
						• • • • • • • • • • • • • • • • • • • •	. ZBRO. NR 50R.	#(1) *SIBCP(I) *CSIBCR(I) *SSIBCP(I) * **voySFR(I) **nSSPR(I) *NSSPR(I) * **(O(I) *SXSR(D(I) *SPPIPP(I) *I * 1 * NSTPS) **I' *I *I * NSTPI) **I' *I *I * NSTPI) **O 30	LIME SOURCE METHOD .JI-SDROR(I-JI-1=1+M50R) =1-MSSMK)	SOURCE PANEL METHOD	FOOR MERIDIONAL INTERPOLATION PERSTIPMES ISOLV PIRET INTERPOLATION

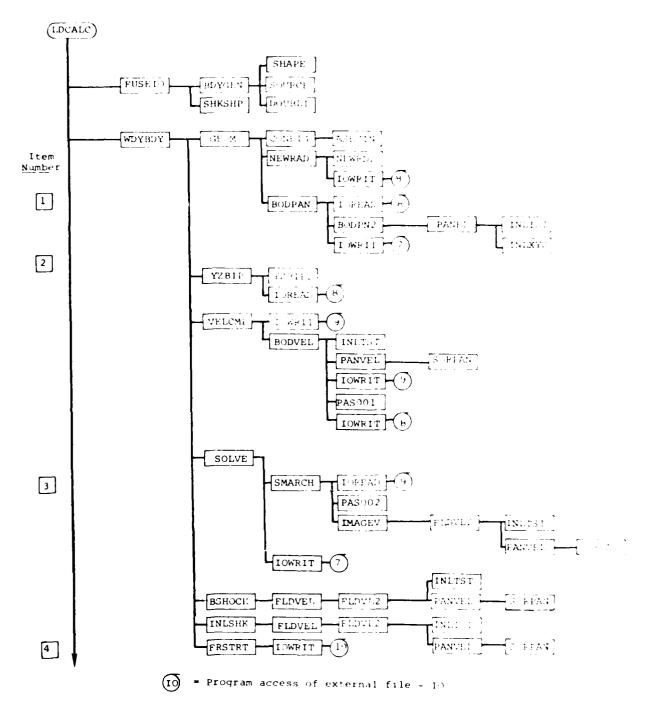


Figure A-2.- General flow chart of Subroutine Calls in Program I.

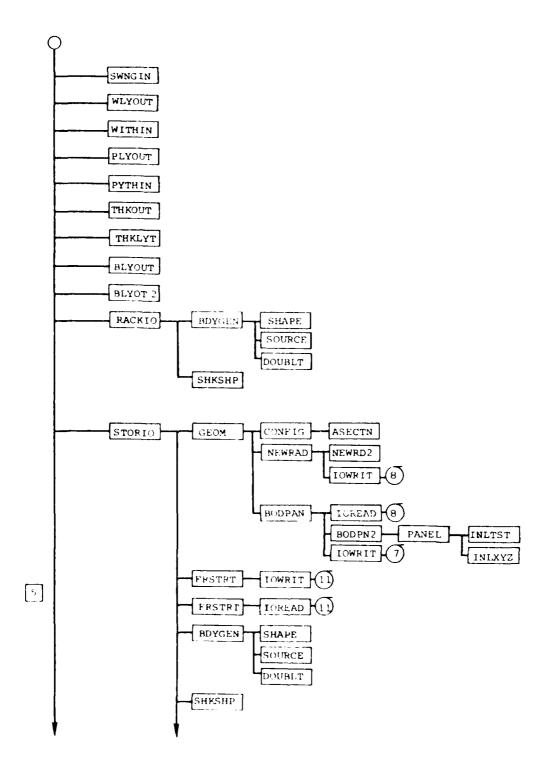


Figure A-2.- Continued.

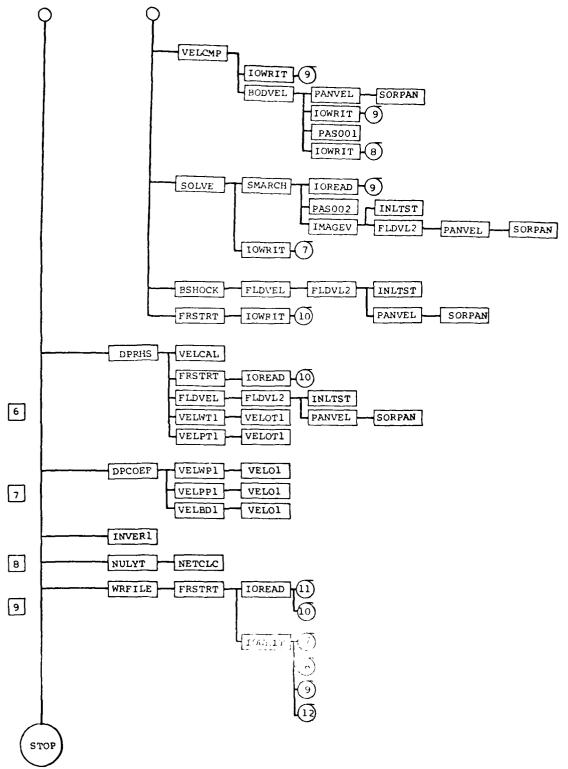


Figure A-2.- Concluded.

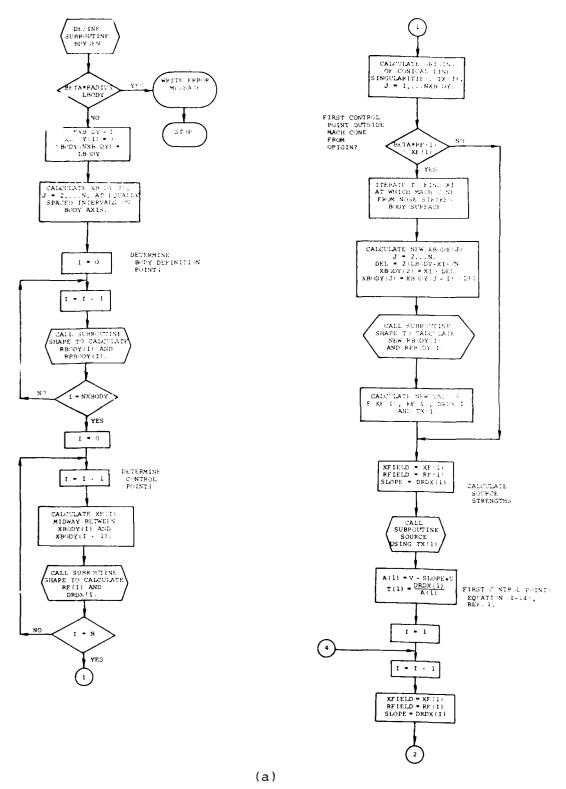


Figure A-3.- Flow chart of subroutine BDYGEN.

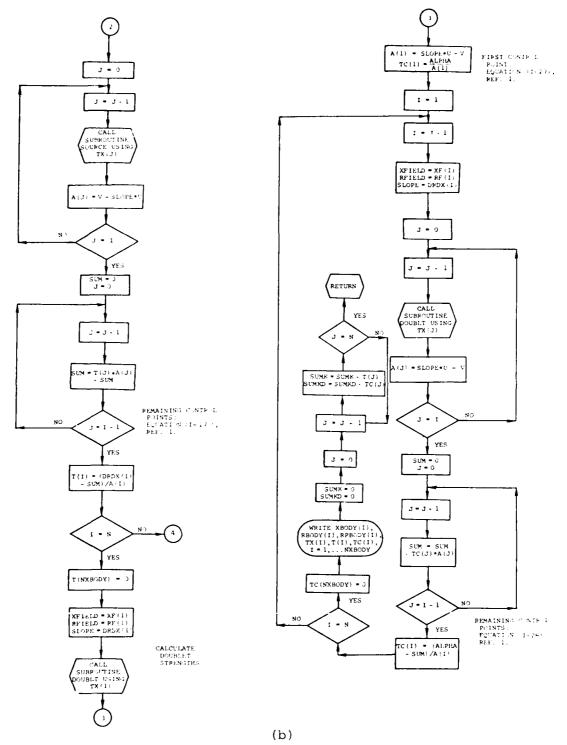


Figure A-3.- Concluded.

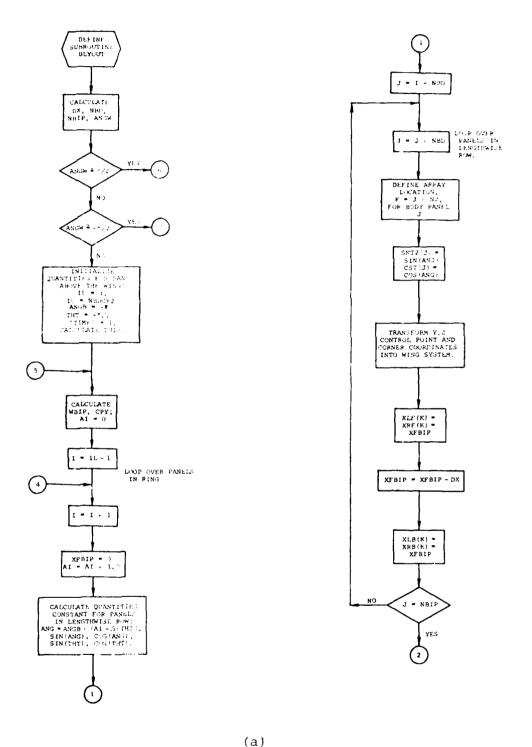
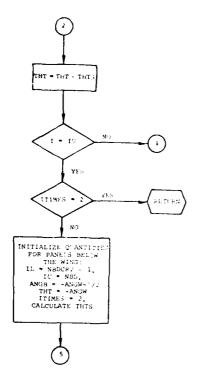
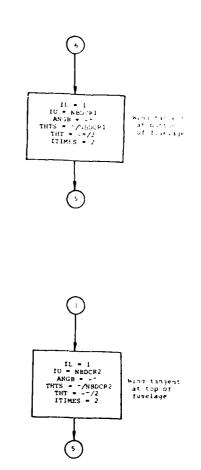


Figure A-4.- Flow chart of subroutine BLYOUT.





(b) Figure A-4.- Concluded.

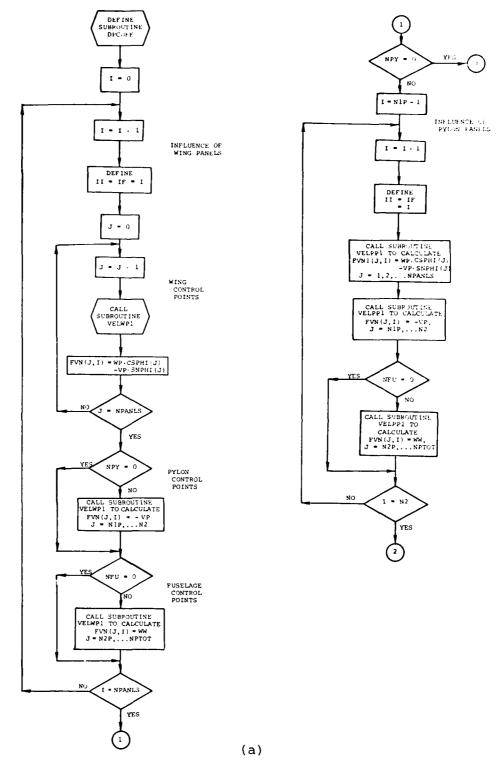
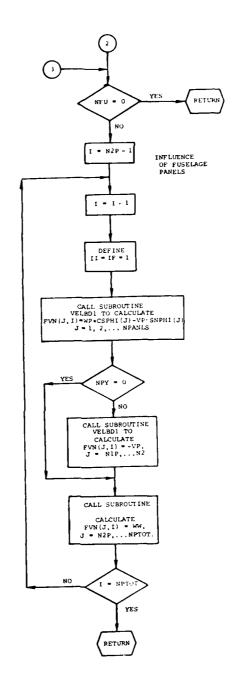
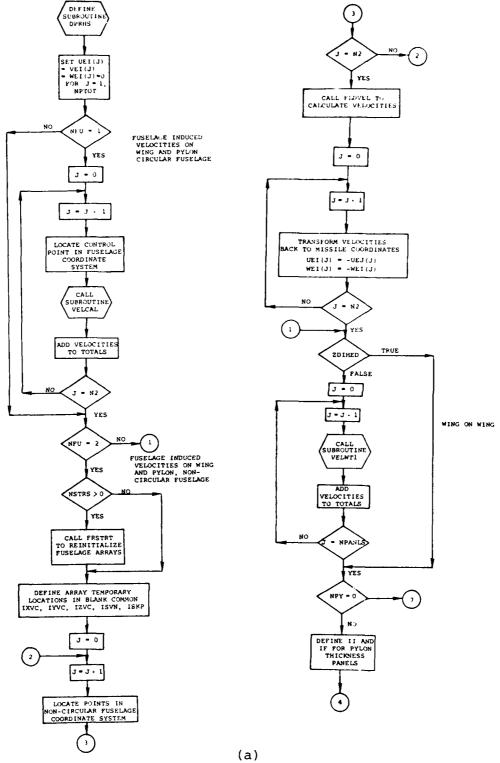


Figure A-5.- Flow chart of subroutine DPCOEF.

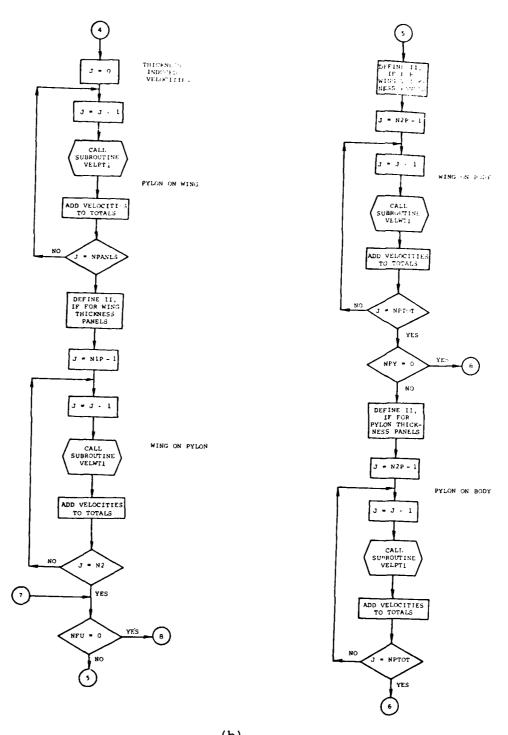


(b)
Figure A-5.- Concluded.

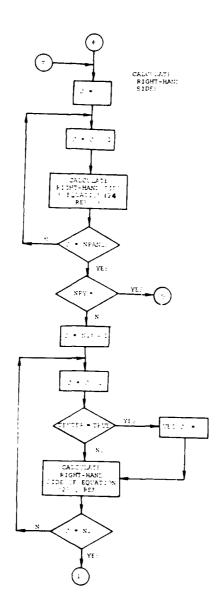


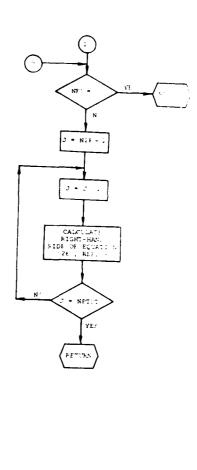
\*\* . \* . \*\*\*

Figure A-6.- Flow chart of subroutine DPRHS.



(b) Figure A-6.- Continued.





(c)
Figure A-6.- Concluded.

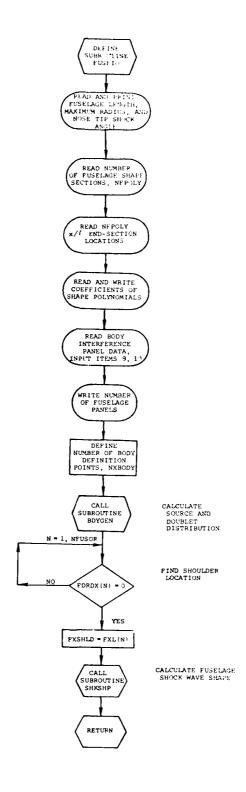


Figure A-7.- Flow chart of subroutine FUSEIO.

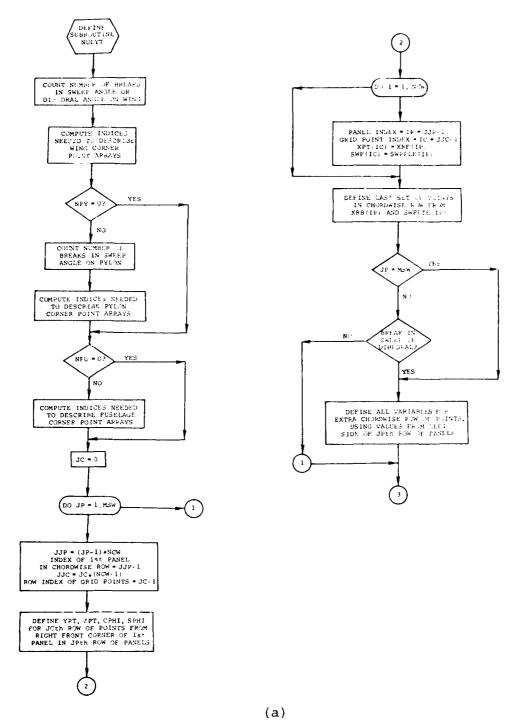


Figure A-8.- Flow chart of subroutine NULYT.

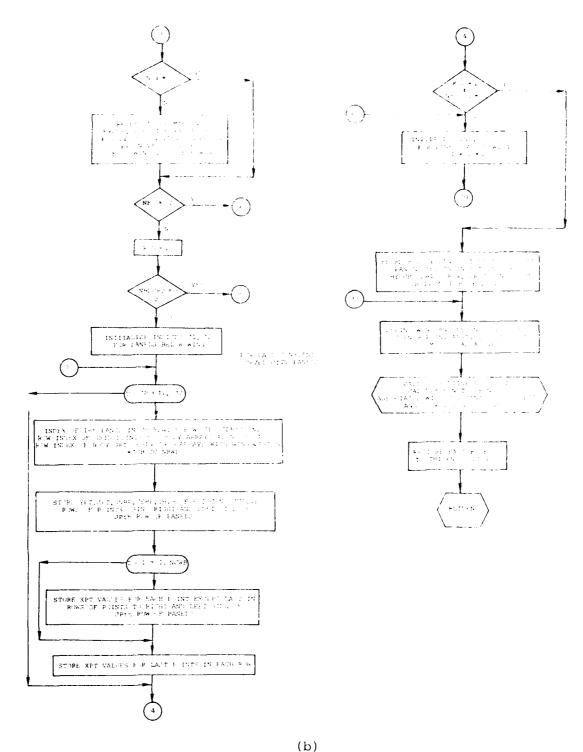


Figure A-8.- Concluded.

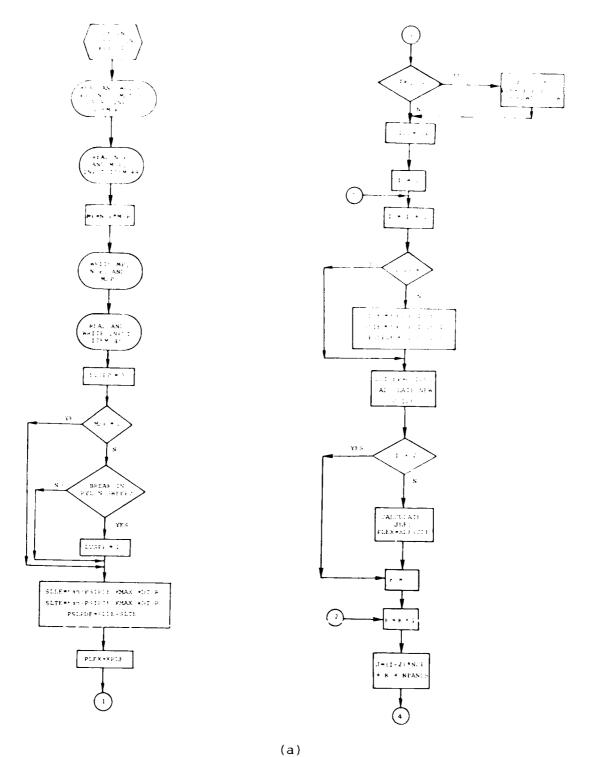
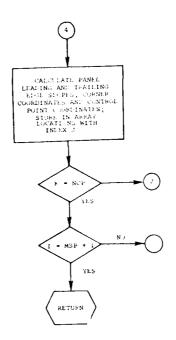


Figure A-9.- Flow chart of subroutine PLYOUT.



(b)
Figure A-9.- Concluded.

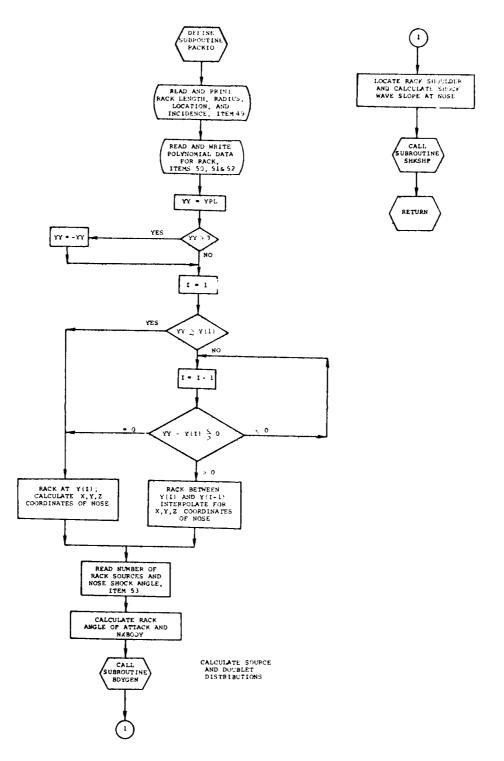


Figure A-10.- Flow chart of subroutine RACKIO.

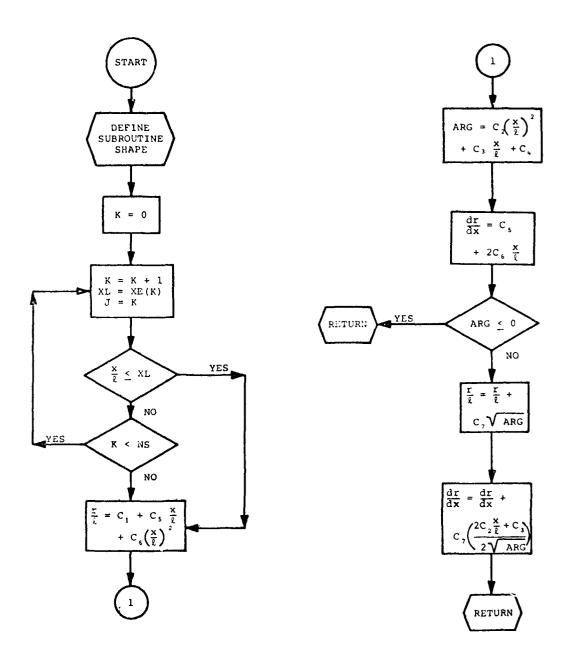
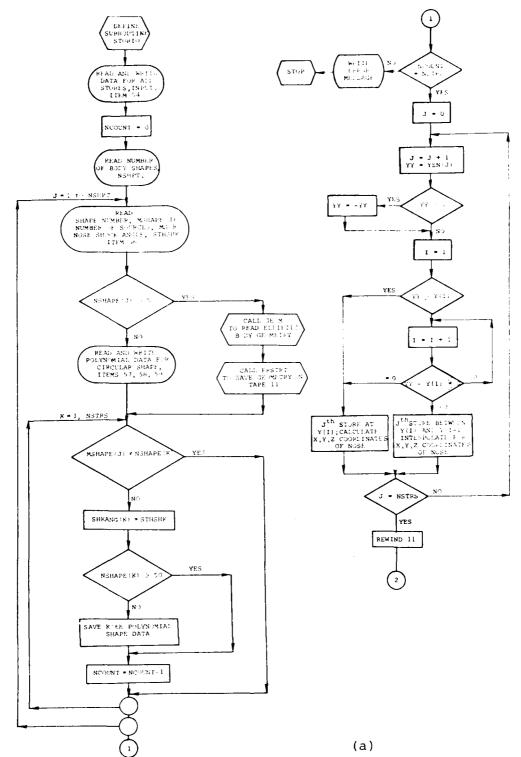
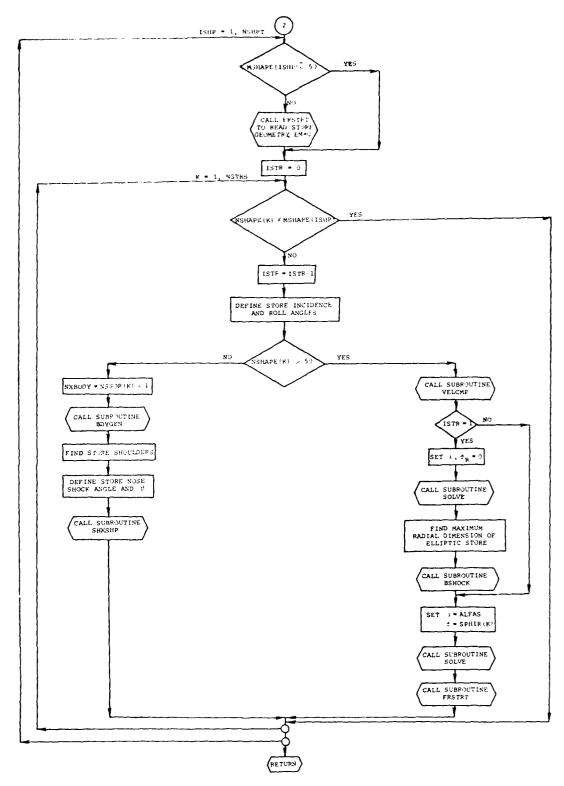


Figure A-11.- Flow chart of subroutine SHAPE.

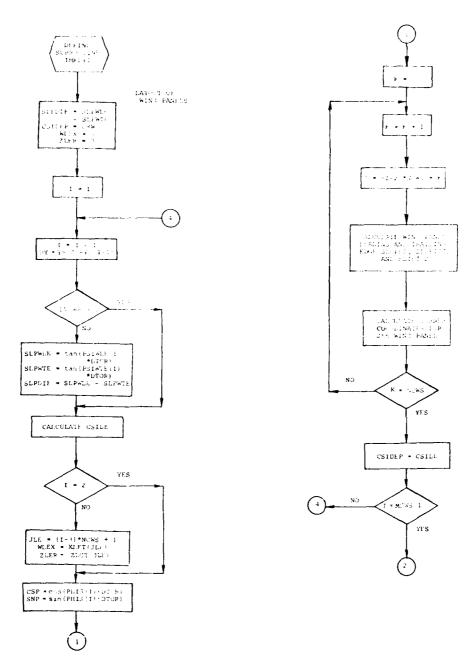


Treatment of the Co.

Figure A-12.- Flow chart of subroutine STORIO.



(b) Figure A-12.- Concluded.



(a) Figure A-13.- Flow chart of subroutine THKLYT.

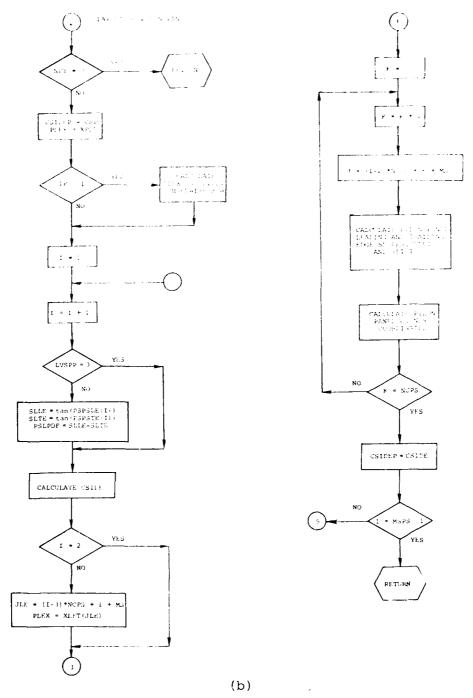
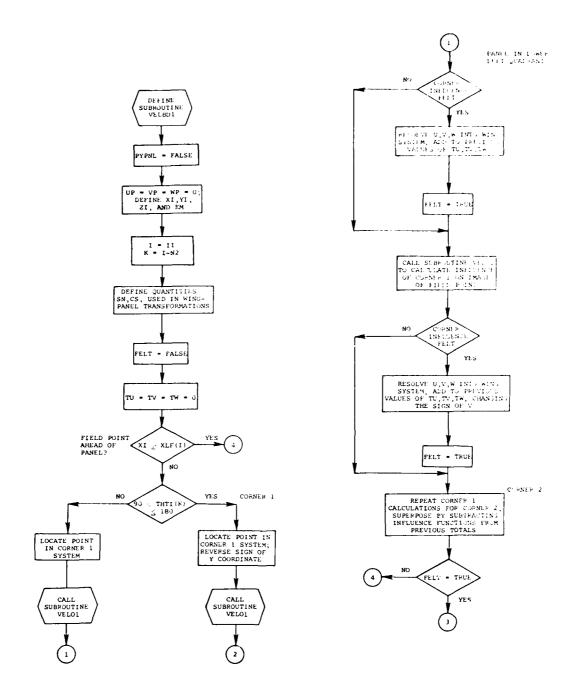
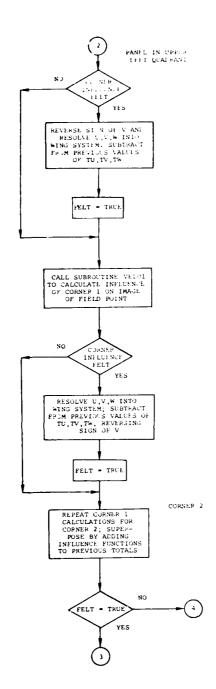
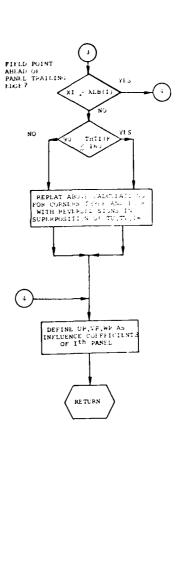


Figure A-13.- Concluded.

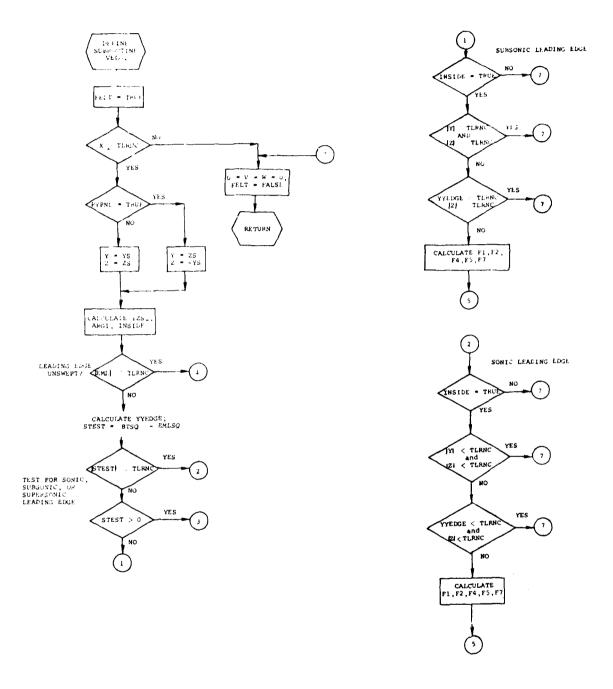


(a) Figure A-14.- Flow chart of subroutine VELBD1.

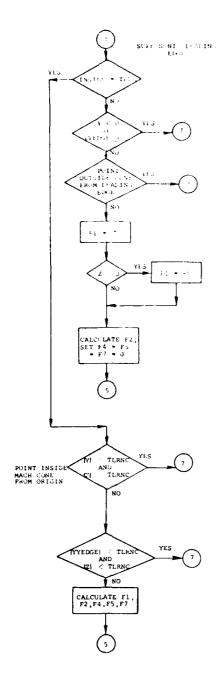


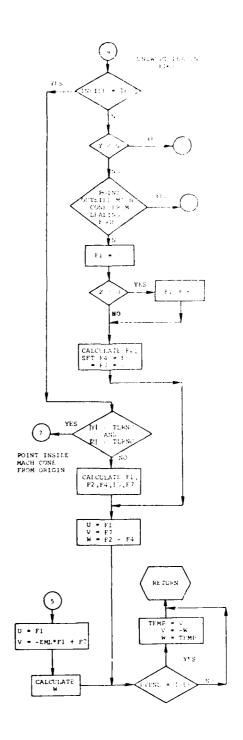


(b)
Figure A-14.- Concluded.



(a) Figure A-15.- Flow chart of subroutine VELO1.





(b)
Figure A-15.- Concluded.

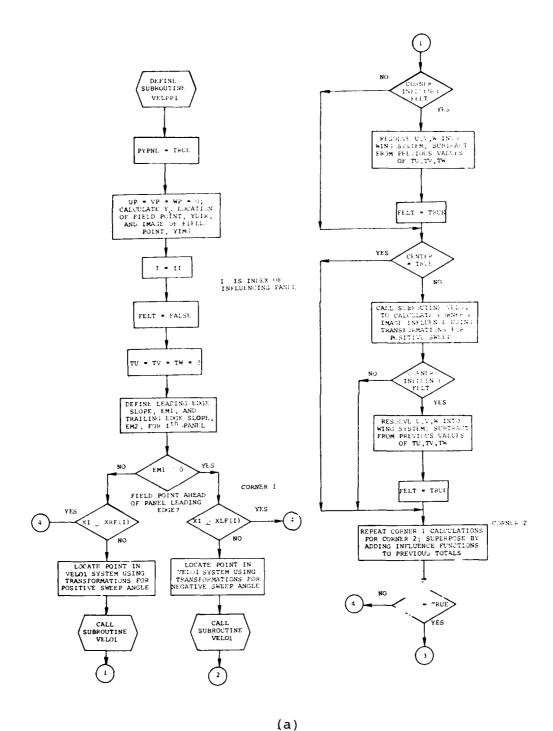
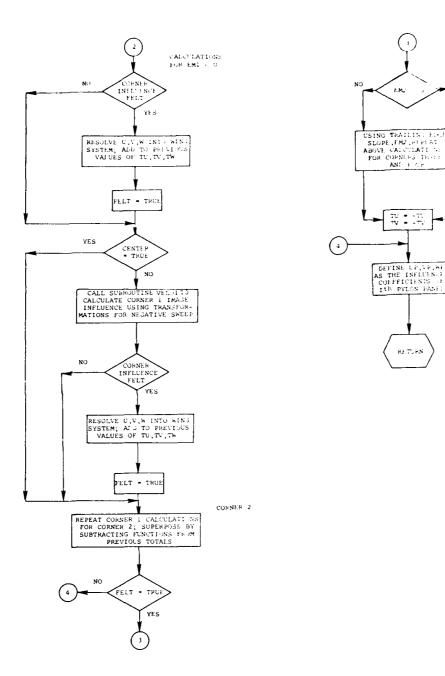
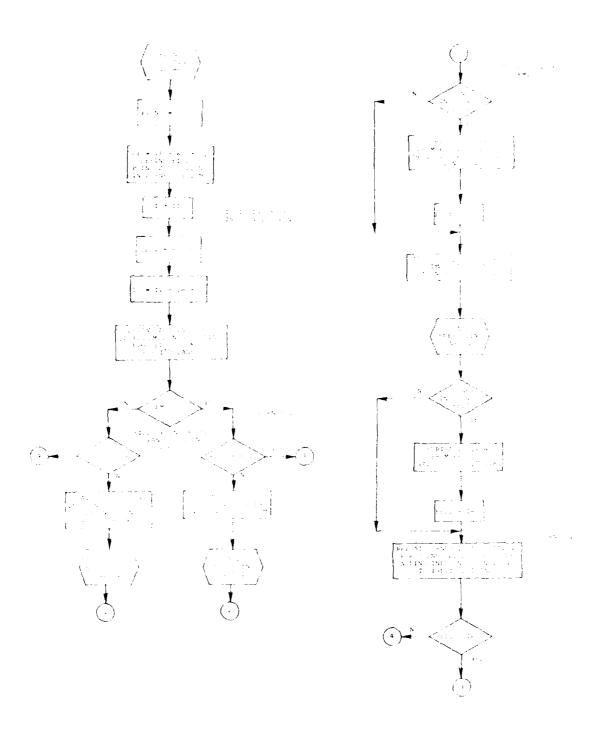


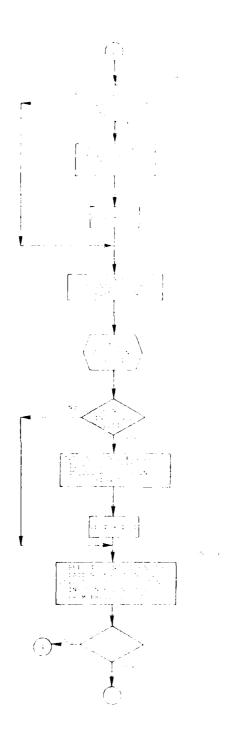
Figure A-16.- Flow chart of subroutine VELPP1.



(b)
Figure A-16.- Concluded.



(a) Figure A-17.- Flow chart of subrouting vELWF1.





(b) Figure A-17.- Concluded.

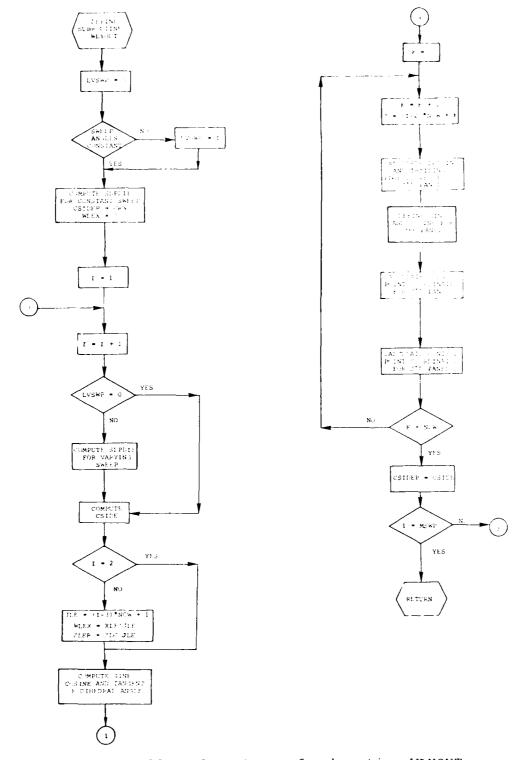


Figure A-18.- Flow chart of subroutine WLYOUT.

#### APPENDIX B

# COMMON BLOCK DESCRIPTIONS - PROGRAM 1

## B-1 Introduction

The purpose of this Appendix is to provide more detailed information on the variables passed between routines through common blocks in Program I. This appendix will present the tables equating program notation to the algebraic notation and variable descriptions. The common blocks are arranged alphabetically. It is followed by a section detailing the special usage of blank common. When a description identifies an item as an input, consult Volume II of this report for further definitions. For variables used both in the description of the noncircular fuselage and elliptic stores, only the input item for the fuselage will be referenced.

A cross-reference chart showing the routines and the common statements contained in each is presented in Figure B-1. Across the top of the chart are the subroutine names including the main program LDCALC. Down the side of the page are the common names. The last one is blank common.

B-2 Description of Variables in Labeled Commons

Var. Engr. Symbol and Description

COMMON /BASESG/ FBASE, FSUMK, FSUMKD, RBASE, RSUMK, RSUMKD, SBASE(7), SSUMK(7), SSUMKD(7)

FBASE	fuselage x-station at which base singularities originate, feet
FSUMK	strength of source originating at fuselage base
FSUMKD	strength of doublet originating at fuselage base
RBASE	<pre>rack x-station at which base singularities originate, feet</pre>
RSUMK	strength of source originating at rack base
RSUMKD	strength of doublet originating at rack base

SBASE	store x-station at which base singularities originate, feet		
SSUMK	strength of source originating at store base		
SSUMKD	strength of doublet originating at store base		
COMMON /BGEOM XJ(51),P	/ XFUS(51), ZFUS(51), FUSARD(51), FUSBY(51), FUSAZ(51), HIK(33)		
XFUS(I)	<pre>x<sub>B</sub> coordinate of Ith station used to define body external geometric shape, feet; input item 18</pre>		
ZFUS(I)	z <sub>B</sub> coordinate of Ith station containing cambered offset, feet; input item 19		
FUSARD(I)	cross sectional area at Ith station, ft <sup>2</sup> ; input item 22		
FUSBY(I)	<pre>b<sub>y</sub>, elliptic horizontal semi-axis (y-direction), feet; input item 23</pre>		
FUSAZ(I)	$a_{\rm Z}$ , elliptic vertical semi-axis (z-direction), feet; input item 24		
ЖJ (J)	<pre>x<sub>B</sub> coordinate of Jth station used to define body panel corners, feet; input item 32</pre>		
PHIK(J)	$\ensuremath{^{\updownarrow}}_k,$ polar angle defining Jth meridian of panel edges, degrees; input item 31		
COMMON /BINLET/ NINLET, NINVEL, NTINL, RVIVO, NINBLK, BTINLT, YCPI, XINLT, YINLT, ZINLT, XINLTE, YINLTE, ZINLTE, JINLT (25)			
NINLET	number of open inlet panels; input item 14		
NINVEL	number of additional panels to be used in velocity calculations for inlet panels; input item 14		
NTINL	total number of inlet panels to be used in a given calculation		
BAIAO	inlet mass flow ratio; ratio of open inlet panel frontal area to total inlet panel area		
NINBLK	number of blocked inlet panels; input item 14		
BTINLT	& associated with inlet panels; input Item 29		

YCPI	y-location of inboard most edge of inlet panels		
XINLT, YINLT, ZINLT	coordinates of outboard leading edge of inlet panels used to locate center of inlet shock propagation		
ZINLTE, YINITE, ZINLTE	coordinates of outboard trailing edge of inlet panels used to locate lower lip of inlet and turning point of shock		
JINLT(I)	fuselage panel number associated with Jth inlet panel		
COMMON /BINSHK/ NIS, XISHLD, EALPI, XCLOSD, MAXSHI, NINL(8), PHINL(8), YINL(8), XINL(80), RINL(80)			
NIS	number of inlet shock traverses; input item 28		
XISHLD	x-station at which 2's associated with inlet return to free stream		
EALPI	angle of attack correction factor for inlet shock ( EALPHA)		
XCLOSD	x-1 cation of leading edge of blocked inlet panels		
MAXSHI	<pre>maximum number of points in inlet shock tables per traverse (=MAXSHK)</pre>		
NINL(I)	number of points computed for Ith shock traverse		
PHINL(I)	angle measured from z-axis below inlet of Ith inlet shock traverse, positive counterclockwise		
YINL(I)	y-station of Ith inlet shock traverse		
XINL	table of x-values of inlet shock		
RINL	table of radial values of inlet shock		
COMMON /BIPYZ/ XBIP, NYZBIP, YCB(31, ZCB(33)			
XBIP	x-station at which the y,z geometry used in the definition of the body interference shell are obtained for the noncircular fuselage, feet		
NYZBIP	number of y,z values used to define panel corners around the circumference of the interference shell; NYZBIP=KRAD of local body segment		

YCB(I)	y-coordinates	of	noncircular	interference	shell,
	feet				

COMMON /BLKPAN/ COST, SINT, XBTJ, YBTJ, ZBTJ, XC1, YC1, ZC1, XPTI, YPTI, ZPTI, COSTI, SINTI, COSD, SIND, LZERO

COST, SINT	$\cos(\theta_j)$ and $\sin(\theta_j)$ , cosine and sine of polar angle of Jth influencing source panel
XBTJ	XPT; coordinate of Jth influencing control point.

YBTJ YPT; coordinate of Jth influencing control point,

feet

ZBTJ ZPT; coordinate of Jth influencing control point,

 $x_B$  coordinate of Jth panel reference corner, feet

YCl  $y_B$  coordinate of Jth panel reference corner, feet

 $z_{\rm R}$  coordinate of Jth panel reference corner, feet

 ${\tt XPTI}$   ${\tt XFT}_i$  coordinate of 1th influenced field point, feet

YPTI YFT; coordinate of Ith influenced field point, feet

ZPTI ZFT; coordinate of Ith influenced field point, feet

COSTI, SINTI  $\cos(\theta_i)$  and  $\sin(\theta_i)$ , cosine and sine of polar angle at Ith influenced panel or field point

COSD,SIND  $\cos{(\delta_i)}$  and  $\sin{(\delta_i)}$ , cosine and sine of panel incidence angle at Ith influenced panel or field point

LZERO PANVEL angle calculation option: F=yes, T=no

COMMON /BODCOM/ AMACH, TAND, CX, XCOR(4), YCOR(4), ZCOR(4), XI, YI, XJ, ZJ, BETAO, BETAL, SUBSON, SUPERS

AMACH Mach number used in source panel influence calculation

TAND	$ an\delta_{\mbox{\scriptsize $j$}}$ , tangent of incidence angle of Jth influencing panel
CX	panel chord length, feet
XCOR(K)	x of Kth corner in local panel system, feet
YCOR(K)	y of Kth corner in local panel system, feet
ZCOR(K)	z of Kth corner in local panel system, feet
XI	x of Ith field point in local panel system, feet
YI	y of Ith field point in local panel system, feet
ZI	z of Ith field point in local panel system, feet
XJ	x of Jth panel control point in panel system, feet
ZJ	z of Jth panel control point in panel system, feet
BETA0	$\sqrt{M_{\infty}^2-1}$ , free stream Mach number constant
BETAL	$\sqrt{M_\ell^2-1}$ , local Mach number constant
SUBSON	subsonic logical indicator; SUBSON = AMACH.LT.1
SUPERS	<pre>supersonic logical indicator; SUPERS = AMACH.GT.1</pre>

COMMON /BOPTNS/ J0,J2,J6,NFUS,NRADX(5),NFORX(5),J2TEST,IPRES,ISOLV, INLET,IPLOT(4),IPRT(5),IUVW,XSTART,XWLE,REFA,REFD,REFL,REFX, CCTEST,ITMAX,BODL,IZ1(12)

J0	reference area indicator; see input item 16
J2	body type indicator; see input item 16
<b>J</b> 6	body camber indicator; see input item 16
NFUS	number of body segments; see input item 16
NRADX(I)	number of points used to define section of Ith body segment
NFORX(I)	number of axial station on Ith body segment
J2TEST	parameter to specify body camber and cross-section definition
IPRES	not used
ISOLVE	not used

INLET logical inlet indicator: true = inlet panels present false = no inlet panel present IPLOT not used optional print control parameter, see input item 14 IPRT component velocity calculation option; see input IUVW item 14 **XSTART** x-station at which pressure integration is started, feet XWLE x-station at which pressure integration is ended, body reference area, ft<sup>2</sup>; see input item 17 REFA REFD body reference length used for moment normalization, feet; see input item 30 REFL body length, feet; see input item 30 REFX, REFZ x,z coordinates of moment reference point, feet; see input item 30 CCTEST solution convergence control criteria (=0.0001) ITMAX solution maximum number of iterations (=20) IZl dummy array, not used COMMON /BPGEOM/ SNT2(200), CST2(200), ZLC(200), ZRC(200), THTI(200), SANGW SNT2(J) sin(ANG,) associated with Jth body panel CST2(J) cos(ANG,) associated with Jth body panel ZLC(I) zw coordinate of left edge of Ith constant u-velocity panel ZRC(I) zw coordinate of right edge of Ith constant u-velocity panel THTI (J) (n - THT<sub>J</sub>); THT<sub>J</sub> is value of THT associated with Jth panel SANGW sin(ANGW) = ZBWO/FRMAX

COMMON /BSHOCK/ NSHK(10), PHIS(10), THEIN(10), MAXSHK, NSHOCK, DBETA, EAFPHA, CNUO, CNU2, MSHEDR, SHE(3), MSHE(100), RSHE(100)

NSHK(I) number of points used to represent Ith modified shock shape

PHIS(I) polar angle at which 1th modified shock is computed, degrees; input item 33

THETN(1) nose limited shock angle of initial shock shape at 1th polar angle, degrees

MAXSHK maximum number of points in 1th shock shape; input item 14

NSHOCK number of modified shock shape computed; input item 14

DBETA not used

EALPHA angle of attack correction to shock shape; input item 15

CNU0, CNU2 not used

XSHLDR  $x_B$  location of body nose shoulder, feet; input item 15

SHK dummy array, not used

XSHK,RSHK arrays containing  $x_B$  and  $r_B$  locations of NSHOCK sets of NSHK(I) points representing the modified nose shock shape, feet

COMMON /CAMBER/ ALPHAL(200)

ALPHAL(J) tan( $\ell_{\ell}$ ), slope of wing camberline at the constant u-velocity panel control points; input item 39

COMMON /CONFIG/ NFU, NPY, NSTRS, LVSWP, NRACK

NFU fuselage indicator; input item 4

NPY pylon indicator; input item 4

NSTRS number of stores indicator; input item 4

LVSWP breaks in wing sweep indicator; LVSWP=0, no;

LVSWP=1, yes

NRACK rack indicator; input item 4

COMMON /CONSTS/ PI, PI2, DTOR, RTOD, FOURPI

ΡΙ

PI2  $\pi/2$ 

DTOR π/180°

RTOD 180°/π

FOURPI 4π

COMMON /DIMENS/ NX,NR,KX,KR,NXNR,KXKR,NXKR,MAXNX,MAXKR,NATOT,
NBODY,KFUS,KRADX(5),KFORX(5),IXC(5),IYC(5),IZC(5),IXZSYM,
NADIM,NXDIM,NG,IXPT,IYPT,IZPT,ITH,IDEL,NTAP7,IAR,IAN,IUB,
IGB(7),IVB,IU,IV,IW,IVA,IWA,ICP,IPHI,IYB,NAG,NAP,NAV,NAS,
NASHK,NAFLD,IAO,IDO,ISKO,IYIM,IZIM,ISVN,ISKP,NRING,IROW(50)

NX sum of axial geometry stations (= \( \Sigma \) NFORX(I))

NR not used

NFUS

KX sum of axial panel geometry stations (=  $\Sigma$  KFORX(I))

KR not used

NXNR sum (=  $\Sigma$  NFORX(I)\*NRADX(I))

NFUS

KXKR sum (=  $\Sigma$  KFORX(I)\*KRADX(I))

NFUS

NXKR sum (=  $\Sigma$  NFORX(I)\*KRADX(I))

MAXNX maximum of (NFORX(I), I=1, NFUS)

MAXKR maximum of (KFORX(I), I=1, NFUS)

NATOT last location accessed in blank common

NBODY number of body panels

KFUS number of body segments paneled (=NFUS)

KRADX(I) number of meridian lines used to define panel edges

on Ith body segment; input item 27

KFORX(I)	number of axial stations used to define leading and trailing edges of panels on Ith body segment; input item 27
IXC(I)	location in blank common of start of XC array for Ith body segment
IYC(I)	location in blank common of start of YC array for Ith body segment
IZC(I)	location in blank common of start of ZC array for Ith body segment
IXZSYM	XZ-plane symmetry option; input item 14
NADIM	dimensioned length of A array in blank common
NXDIM	maximum allowable number of axial stations (=51)
NG	last location in blank common containing source panel geometry arrays
IXPT	location in blank common of start of control points, XPT
IYPT	location in blank common of start of control points, YPT
IZPT	location in blank common of start of control points, ZPT
ITH	location in blank common of start of array THET
IDEL	location in blank common of start of array DELTA
NTAP7	number of variables last written on TAPE7
IAR	location in blank common of start of panel areas, AREA
IAN	location in blank common of start of temporary array AN containing influence coefficients
IUB	location in blank common of start of temporary array UB containing U,V,W influence coefficients
IGB(IALP)	location in blank common of start of IALPth array containing the source strength solution, GB
IVB	location in blank common of start of temporary array, VB, containing normal velocity boundary conditions

IU	location in blank common of start of U velocities
1 V	location in blank common of start of V velocities
IW	location in blank common of start of W velocities
IVA, IWA	location in blank common of start of additional temporary velocity arrays
TCP	location in blank common of start of pressure coefficient, CP, array
IPHI	location in blank common of temporary PHI array
ITB	location in blank common of start of coordinates YB and ZB of temporary cross section geometry in NEWRAD
NAG	maximum locations in blank common required in GEOM
NAP	not used
NAV	maximum locations in blank common required in VELCMP
NAS	maximum locations in blank common required in SOLVE
NASHK	maximum locations in blank common required in BSHOCK
NAFLD	maximum locations in blank common required in FLDVEL
IAO	offset location in blank common of all above arrays when multiple configurations are simultaneously in core
IDO	offset location in blank common of ID array containing /DIMENS/ information for additional source panel configurations in core
ISK0	offset location in blank common of array containing information in common /BSHOCK/ for additional source panel configurations in core
IYIM, IZIM	location in blank common of start of image store Y and Z control point coordinates
ISVN, ISKP	location in blank common of start of temporary arrays, SVN and LSKP
NRING	number of rings of panels on body
IROW(I)	number of panels around Ith ring of panels

COMMOR /EXVEL/ UET(200), VET(200), WET(200), CIE: 200)

UEI(I)  $u_{W_{1,1}}/V$  at the v = 1th control point

VEI(I)  $V_{W_{1,y}}/V_y$  at the y = 1th control point

WEI(I)  $w_{W_{1,1}}/V_{\infty}$  at the V = Ith control point

CIR(1) array containing right-hand sides of u-velocity equations

COMMON /FLOW/ ALFACR, GAMF, FMACH, RHO, VINF, BETA, BETASQ, FMCHSQ

ALFACR  $\alpha_{f}$ , radians

GAMF not used

FMACH M; input item 3

RHO not used

VINF not used

BETA  $3 = \sqrt{M_{\odot}^2 - 1}$ 

BETASO 82

FMCHSQ M2

COMMON /FSGEOM/ FRMAX, SSPAN, FLTHC, BODYPL

FRMAX fuselage maximum radius; input item 5

SSPAN wing semispan, feet; input item 35

FLTHC fuselage length, feet; input item 5

BODYPL body interference shell length, feet; input item 10

COMMON /FSHOCK/ NFSHK, FXSHK(50), FRSHK(50), FDRDX(101)

NFSHK number of x and r values in fuselage nose shock

table generated from line singularities

FXSHK(I), x and r coordinates of Ith circular fuselage nose

FRSHK(I) shock location at zero angle of attack

FDRDX(J) DR/DX at Jth circular fuselage control point

COMMON /FSOR/ FXL(101), FSS(100), FDS(100), NFSOR

FXL array containing the x positions of the fuselage

sources; positive, measured from tip of nose

FSS array containing the strengths of the circular

fuselage source distribution

FDS array containing the strengths of the circular

fuselage doublet distribution

NFSOR number of circular fuselage sources and doublets;

input item 9

COMMON /HEAD/ TITLE1(20), TITLE2(20)

TITLE1 array containing hollerith description of non-

circular body external geometry

TITLE2 array containing hollerith description of non-

circular body paneling distribution

COMMON /ICVEL/ UP, VP, WP, II, IF, DELTP (200)

UP  $u/V_{\infty}$  perturbation velocity at a control point due

to pylon or wing thickness; also u-velocity panel

u influence function at a control point

VP  $v/V_{\infty}$  perturbation velocity at a control point due

to pylon or wing thickness; also u-velocity panel

v influence function at a control point

WP  $w/V_{\infty}$  perturbation velocity at a control point due

to pylon or wing thickness; also u-velocity panel

w influence function at a control point

II, IF initial and final values, respectively, of thickness

panel index

DELTP  $1/\pi (u_{\perp}/V_{\infty})$ ; u-velocity panel strength

COMMON /INDEX/ NCW, MSW, MSWP, NPANLS, NCWB, NBDCR1, NBDCR2, NBD, NBIP, MP, NCP, MSP, N1P, N2, N2P, NPTOT

MP, NCP, MSP, NIP, NZ, NZP, NP101

NCW number of wing panels chordwise, input item 36

MSW number of wing panels spanwise, input item 36

MSWP MSW+1

NPANLS number of u-velocity panels on left wing panel:

NCW\*MSW

NCWB number of BIP rings, input item 9

NBDCRl number of panels in ring above wing, input item 9

NBDCR2 number of panels in ring below wing, input item 9

NBD total number of fuselage u-velocity panels in a

ring on the half body

NBIP number of u-velocity panels on fuselage;

NBIP = NBD\*NCWB

MP number of u-velocity panels on pylon;

MP = NCP\*MSP

NCP number of pylon panels chordwise, input item 44

MSP number of pylon panels spanwise, input item 44

N1P NPANLS + 1

N2 NPANLS + MP

N2P N2 + 1

NPTOT NPANLS + MP + NBIP

COMMON /NUINDX/ KW, KP, NRW, NRP, NRB, NPTW, NPTP, NPTB, NRTOT, NPTT, NRWS, NRPS, NPTWS, NPTPS, NRTOTS, NPTTS, NRWP, NPTWP, NCW1, NCP1, NCW81, NCPS1

KW number of breaks in sweep and/or dihedral on wing

KP number of breaks in sweep on pylon

NRW = MSW + KW + 1

NRP = MSP + KP + 1

NRB NRB = 2 \* NBD

NPTW = NCW + NRW + 1

NPTP = NCP + NRW + 1

NPTB = NCWB + NRB + 1

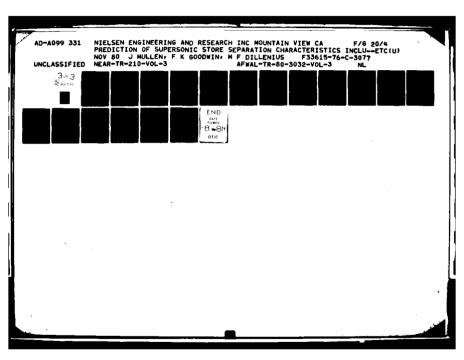
NRTOT = NRW + NRP + NRB

NPTT = NPTW + NPTP + NPTB

```
NRWS - MSW5 + KL + I
NRNG
NRDS
               NRPS = MSPS + KP + I
               SPTWS - NCWS + NRWS + I
RPTWS
                NETPS - NCTS + NRES + 1
NPTES
                NRTOTS = NRWS + NRPS
NRTOTE
                HPTTS - NPTWS + NPTPS
NPTTS
                NRWP = NPW + NRP
Nichele
                NPTWP - NPTW + MPTP
NETVE
NCV1
                NCWI = NCW + I
                NCP1 NCP + 1
NCP1
                NCWR1 = NCWB + 1
NCWB1
NCASI
                NCWS1 = NCWS + 1
               %CPSI = 10013 1
NGESL
COMMON (FARAM) KAACH, ALPHA, BETA, ALPHAC, PHIR, EM, SINAC, COSAC,
     SPHI, CPHI, SINA, SINE
KMACH
                Mach number seem by source panels
ALPHA
                , tree stream angle of attack seen by source panels,
                degrees (*sin<sup>-1</sup>(sin(ALPHAC) · cos(PHIR))
                -, free stream angle of sideslip seem by source panels, degrees (-sin<sup>-1</sup>(sin(ALPHAC) *sin(PHAC))
BETA
                c, included angle of attack seen by source panels,
ALPHAC
                dear is
PHIR
               :,, angle of roll seem by source panels
\mathbb{D}M
                temporary Mach number of last computation
SINAC
               Bun ( - _ )
COSAC
               cos(-g)
               sin(:,)
SPHI
```

 $CP \cap L$ 

cos(:,)



SINA  $sin(\alpha)$ 

SINB  $sin(\beta)$ 

COMMON /PYGEOM/ Z(20), XPLE, YPL, CRP, HP, PSIPLE(20), PSIPTE(20), IP, SLLE, PSLPOF, CENTER, ZPL, LVSPP

Z(K) z<sub>p</sub> locations of pylon u-velocity panel side edges;

input item 45

XPLE location of pylon root chord leading edge; input

item 43

YPL yw location of the pylon; YPL=Y(IP) of input

item 37

CRP pylon root chord; input item 43

HP pylon height; input item 43

PSIPLE(K) leading-edge sweeps of pylon u-velocity panels;

input item 45

PHIPTE(K) trailing-edge sweeps of pylon u-velocity panels;

input item 45

IP index of  $y_w$  location of the pylon; input item 43

SLLE slope of pylon leading edge for Ith chordwise row

of pylon panels

PSLPDF difference in leading and trailing edge slopes

PSLPDF = SLLE-SLTE for Ith chordwise row of

pylon panels

CENTER logical test for centerline pylon (CENTER=YPL.EQ.0)

ZPL z<sub>w</sub> location of the pylon; ZPL=ZLC((IP-2) • NCW+1)

LVSPP breaks in pylon sweep indicator, LVSPP=0, no;

LVSPP=1; yes

COMMON /RKGEOM/ RRMAX, RLTHC, XWROC, YWRO, ZERO, NRPOLY, RXEND(7), RCOEF(7,7), XBRO, YBRO, ZBRO, RIBCR, SRIBCR, CRIBCR

RRMAX maximum rack radius; input item 49

RLTHC length of rack; input item 49

XWROC x., location of rack in wing coordinates, feet

YWRO y location of rack in wing coordinates, feet

ZWRO z, location of rack in wing coordinates, feet

NRPOLY number of rack shape polynomials; input item 50

RXEND(J) rack polynomial endpoints; input item 51

RCOEF(I,J) rack polynomial coefficients; input item 52

XBRO  $x_{p}$  location of rack in body coordinates, feet

YBRO y<sub>R</sub> location of rack in body coordinates, feet

ZBRO z<sub>R</sub> location of rack in body coordinates, feet

RIBCR RIC DTOR; input item 49 for RIC

SRIBCR sin(RIBCR)

CRIBCR cos(RIBCR)

COMMON /RSHOCK/ NRSHK, RXSHK(50), RRSHK(50), RDRDX(101)

NRSHK number of x and r values in rack nose shock table

generated from line singularities

RXSHK(I), x and r coordinates of Ith rack nose shock location

RRSHK(I) at zero angle of attack, feet

RDRDX(J) DR/DX at Jth rack control point

COMMON /RSOR/ RXL(101), RSS(101), RDS(101), NRSOR

RXL array containing the x positions of the rack

sources; positive, measured from tip of rack nose

RSS array containing the strengths of the rack source

distribution

RDS array containing the strengths of the rack

doublet distribution

NRSOR number of rack sources and doublets; input item 53

COMMON /SHPDAT/ NFPOLY, FXEND(7), FCOEF(7,7)

NFPOLY number of fuselage polynomials; input item 6

FXEND  $x/\ell$  of fuselage polynomial endpoints; input

item 7

FCOEF coefficients of fuselage polynomials; input

item 8

COMMON /SSHOCK/ NSSHK(7), SXSHK(50,7), SRSHK(50,7), SDRDX(101,7)

NSSHK(J) number of x and r values in Jth store nose shock table generated from line singularities

SXSHK(I,J), x and r coordinates of Ith circular store shock SRSHK(I,J) location at zero angle of attack for Jth store

SDRDX(K,J) DR/DX at Kth circular store control point of Jth store

COMMON /SSOR/ SXL(101,7),SSS(100,7),SDS(100,7),NSSOR(7)

SXL(I,J) Ith x-position of Jth circular store sources; positive measured from tip of nose

SSS(I,J) Ith source strength of distribution for Jth circular store

SDS(I,J) Ith doublet strength of distribution for Jth circular store

NSSOR(J) number of Jth circular store sources and doublets; equal to input item 56

COMMON /STGEOM/ SRMAX(7), SLTHC(7), XWSOC(7), YWSO(7), ZWSO(7), NSPOLY(7), SXEND(7,7), SCOEF(7,7,7), XBSO(7), YBSO(7), ZBSO(7), SIBCR(7), NUMSTR(7), SSIBCR(7), CSIBCR(7), SPHIRR(7), NSHAPE(7), NSHPT, MSHAPE(7)

SRMAX(J) maximum radius of Jth store; input item 54

SLTHC(J) length of Jth store; input item 54

XWSOC(J) x. coordinate of tip of nose of Jth store

YWSO(J) y coordinate of tip of nose of Jth store

ZWSO(J)	$\mathbf{z}_{\mathbf{W}}^{}$ coordinate of tip of nose of Jth store
NSPOLY(J)	number of polynomials used to specify the shape of the Jth store
SXEND(I,J)	endpoints of polynomial sections specifying shape of Jth store
SCOEF(I,K,J)	Jth coefficient of Ith polynomial describing the shape of the Jth store
XBSO(J)	x <sub>B</sub> coordinate of tip of nose of Jth store
YBSO(J)	yB coordinate of centerline of Jth store
ZBSO(J)	$\mathbf{z}_{\mathbf{B}}$ coordinate of tip of nose of Jth store
SIBCR(J)	SIC(J)*DTOR; input item 54 for SIC(J)
NUMSTR(J)	store number; input item 54
SSIBCR(J)	<pre>sin(SIBCR(J))</pre>
CSIBCR(J)	cos(SIBCR(J))
SPHIRR(J)	initial roll angle of Jth store coordinate axes; positive right wing down, radians
NSHAPE(J)	store shape number, input item 54
NSHPT	number of different store shapes; input item 55
MSHAPE(K)	shape number of Kth store shape; input item 56
COMMON /SRCE/	XFIELD, RFIELD, BSQ, X2, U, V, VT
XFIELD	center of line source/doublet segment, feet
RFIELD	circular body radius at XFIELD, feet
BSQ	not used
X2	not used
U	axial velocity due to a source
v	radial velocity due to a source
VT	not used

COMMON /THKDAT/ NCWS,NCPS,MS,MPS,MSWS,MSPS,NTHP,XRFT(400),XRBT(400),
XLFT(400),XLBT(400),YRCT(400),YLCT(400),ZRCT(400),ZLCT(400),
THETAL(400),THETPL(200),SLLET(400),SLTET(400),DZDX(400),
YS(20),PSWSLE(20),PSWSTE(20),PHIS(20),ZS(20),PSPSLE(20),
PSPSTE(20),SNPHS(400),CSPHS(400)

NCWS number of wing thickness panels in a chordwise row; input item 40

NCPS number of pylon thickness panels in a chordwise row; input item 46

MS number of thickness panels on wing

MPS number of thickness panels on pylon

MSWS number of wing thickness panels in a spanwise row; input item 40

MSPS number of pylon thickness panels in a spanwise row; input item 46

NTHP number of thickness panels on wing and pylon

 $x_w$  coordinate of right front corner of Ith thickness panel

 $x_{W}$  coordinate of right rear corner of Ith thickness panel

 $\mathbf{x}_{\mathbf{w}}$  coordinate of left front corner of Ith thickness panel

 $\mathbf{x}_{\mathbf{w}}$  coordinate of left rear corner of Ith thickness panel

YRCT(I) yw coordinate of right side of Ith thickness panel

YLCT(I) y coordinate of left side of Ith thickness panel

ZRCT(I) z<sub>w</sub> coordinate of right side of Ith thickness panel

ZLCT(I) z coordinate of left side of Ith thickness panel

THETAL(I) wing thickness slopes; input item 42

THETPL(I) pylon thickness slopes; input item 48

SLLET(I) slope of leading edge of Ith thickness panel

SLTET(I) slope of trailing edge of Ith thickness panel

DZDX(I)	dz/dx of Ith thickness panel	
YS(J)	$\mathbf{y}_{\mathbf{W}}$ locations of wing thickness panel side edges; input item 41	
PSWSLE(J)	<pre>leading-edge sweeps of wing thickness panels; input item 41</pre>	
:SWSTE(J)	trailing-edge sweeps of wing thickness panels; input item 41	
PHIS(J)	wing thickness panel dihedrals; input item 41	
2S(J)	<pre>z<sub>p</sub> locations of pylon thickness panel edges; input item 47</pre>	
PSPSLE(J)	<pre>leading-edge sweeps of pylon thickness panels; input item 47</pre>	
PSPSTE (J)	trailing-edge sweeps of pylon thickness panels; input item 47	
SNPHS (J)	sin(PHIS(J))	
CSPHS(J)	cos(PHIS(J))	
COMMON /THVAR	G/ X,YV,ZV,U,VV,WV,EML,PRT*	
X,YV,ZV	x,y,z coordinates of field point in thickness panel coordinate system	
U,VV,WV	u, v, w velocity components in thickness panel coordinate system	
EML	slope of thickness panel leading or trailing edge	
PRT	not used	
COMMON /VELARG/ X,YV,ZV,U,VV,WV,EM,TLRNC,TIPY,PYPNL*		
X,YV,ZV	x,y,z coordinates of field point in u-velocity panel coordinate system	
U,VV,WV	<pre>u,v,w velocity components in u-velocity panel coordinate system</pre>	

<sup>\*</sup>Variable names may differ from routine to routine but the definitions are unchanged.

EM slope of u-velocity panel leading or trailing edge

TLRNC error tolerance

TIPY exposed wing span

PYPNL logical pylon indicator

COMMON /WGEOM/ XBWCC, ZBWO, CRW, SLPWLE, SLPWTE, PSIWLE(20), PSIWTE(20), Y(20), PHID(20), ZDIHED, WICR

XBWOC x<sub>B</sub> coordinate of wing root chord leading edge;

input item 34

ZBWO z<sub>B</sub> coordinate of wing root chord leading edge;

input item 34

CRW wing root chord; input item 35

SLPWLE tan (PSIWLE(I))

SLPWTE tan(PSIWTE(I))

PSIWLE(I) leading-edge sweeps of wing u-velocity panels;

input item 37

PSIWTE(I) trailing-edge sweeps of wing u-velocity panels;

input item 37

Y(I) yw locations of wing u-velocity panel side edges;

input item 37

PHID(I) dihedral angles of wing u-velocity panel sections;

input item 37

ZDIHED logical variable indicating whether or not there

is wing dihedral; ZDIHED=TRUE, no dihedral;

=FALSE, there is dihedral

WICR wing incidence angle, radians; computed from WIC,

input item 34

COMMON /WPGEOM/ XRF(200), XRB(200), XLF(200), XLB(200), YRC(200), XLG(200), YRC(200), YRC(200),

YLC(200), SCPT(200), YCPT(200), ZCPT(200), SWPPLE(200),

SWPPTE (200), SNPHI (200), CSPHI (200)

XRF(I)  $x_w$  coordinate of right rear corner of Ith constant

u-velocity panel

XRB(I) xw coordinate of left front corner of Ith constant

u-velocity panel

XLF(I)	$\mathbf{x}_{\mathbf{w}}$ coordinate of left rear corner of Ith constant u-velocity panel	
XLB(I)	$\mathbf{x}_{\mathbf{W}}$ coordinate of right front corner of Ith constant u-velocity panel	
YRC(I)	$\mathbf{y}_{\mathbf{W}}$ coordinate of left edge of Ith constant u-velocity panel	
YLC(I)	$\mathbf{y}_{\mathbf{W}}$ coordinate of right edge of Ith constant u-velocity panel	
XCPT(I)	$x_W$ coordinate of Ith control point	
YCPT(I)	$\mathbf{y}_{\mathbf{W}}$ coordinate of Ith control point	
ZCPT(I)	$z_{\overline{W}}$ coordinate of Ith control point	
SWPPLE(I)	sweep of leading edge of Ith constant u-velocity panel on wing, fuselage or pylon	
SWPPTE(I)	sweep of trailing edge of Ith constant u-velocity panel on wing, fuselage or pylon	
SNPHI(I)	sine of dihedral angle of Ith constant u-velocity panel on wing	
CSPHI(I)	cosine of dihedral angle of Ith constant u-velocity panel on wing	
COMMON /XSHOLD/ FXSHLD, RXSHLD, SXSHLD(7)		
FXSHLD	$\mathbf{x}_{\mathrm{B}}$ location of circular fuselage shoulder, feet	
RXSHLD	x <sub>R</sub> location of rack shoulder, feet	
SXSHLD(J)	x <sub>S</sub> location of Jth circular store shoulder, feet	

### B-3 Blank Common

The requirement for handling the many large arrays associated with the solution for u-velocity and source panel strengths has necessitated both the use of out of core data handling and storage and the setting aside of a scratch storage area in core to be used for more than one purpose. To handle the latter data requirement blank common has been reserved for all calculations involving large arrays. The program flow of calculations is thus arranged to allow variables to be read from or written to external files as needed. The following describes the Program I sequence of references to external files and which arrays reside in blank common at each point in the program flow. The information residing in each of the external files is described later.

In Program I blank common is used for three purposes: (1)storing the dynamically dimensioned arrays associated with both the noncircular fuselage and the elliptic store; (2) storing the wing-fuselage u-velocity aerodynamic influence coefficients during the solution for panel strengths; and (3) temporary storage of arrays associated with the summation of u-velocity singularity strengths at panel corners. The descriptions which follow focus on the definition of quantities during these phases. The noncircular fuselage and elliptic store arrays are lumped together because they share common code. Only the dimensions of arrays will vary between components. The arrangement of variables in blank common during these calculations may change dynamically as the solution progresses as temporary arrays are required or dis-The flow chart in Figure A-2 of Appendix A also identifies several points in the program, item numbers, where external files are referenced. The comments which follow are keyed to the usage of blank common at those points wherever possible. The descriptions of the use of blank common during these three phases follow.

The first use of blank common is to store the arrays of panel properties and solutions of either the noncircular fuselage or the

elliptic store. This spans items 1 through 4 for the fuselage and repeats as item 5 for the store in Figure A-2. The first routine using blank common is GEOM as called from WDYBDY. The noncircular and elliptic store both share the same analysis routines and blank common data arrays. In Program I, the results of the first are computed and all information required for Program II are saved. The solution for a single body is broken into four parts. follow the progress of calculations and correspond to generation of panel geometry, computation of panel aerodynamic influence coefficients, solution of the equations, and saving of appropriate arrays required for Program II. Because of the large number of possible combinations of paneling schemes, all array storage allocation in blank common is performed dynamically. That is, the array length is computed and core locations set aside prior to calculation of the array itself. Arrays are typically stacked one behind another with no unused locations in between. No explicit array names or dimensions are defined in blank common. Only the address in blank common of the first element in the array is saved in labeled common, DIMENS.

The first use of blank common within the calculation of the source panel geometry (item 1) is for temporary storage of the arbitrary Y,Z input of the external fuselage shape as read directly from input cards. They are followed by the intermediate YB and ZB values computed at axial stations, XFUS, at the new meridional angles, PHIK, of the revised panel spacing layout. Blank common is equivalently dimensioned to:

COMMON SFUS (NRAD, 2, NFUSOR), YB (NFUSOR, KRAD), ZB (NFUSOR, KRAD), ... A (NADIM)

#### where

- SFUS(NN,1,N) y-station in local body coordinates of the NNth meridian at the Nth axial station, XFUS
- SFUS(NN,2,N) z-station in local body coordinates of the NNth meridian at the Nth axial station, XFUS

YB(N,K)	y-station in	local body	coordinate	s of the Nth
	axial station angle	for the K	th revised	meridional

z-station in local body coordinates of the Nth ZB(N,K)axial station for the Kth revised meridional angle

If more than one segment exists YB and ZB are saved on TAPE8 for each of NFUS segments.

The second change in the use of blank common as identified by item 2 in Figure A-3 is to store the arrays containing the geometric properties of the source panels. The configuration of blank common at this point in the calculations remains the same while continuing to grow. Arrays which are to be saved are located at the beginning with scratch space at the rear. From the end of the calculations in GEOM, the arrays in blank common contain all the panel geometric properties required for calculation of influence coefficients and the resolution of forces and moments. Additional temporary arrays are allocated to hold the ring-by-ring coefficient arrays in VELCMP. The equivalently dimensioned arrays in blank common look like:

XPT (NBODY), YPT (NBODY), ZPT (NBODY), THET (NBODY), COMMON DELTA (NBODY), AREA (NBODY), XC(KX), YC(KXKR), ZC(KXKR), AN(MAXKR, MAXKR), UB(3, MAXKR, MAXKR),..., A (NADIM)

## where

XPT(I)	x-station of control point of Ith panel
YPT(I)	y-station of control point of Ith panel
ZPT(I)	z-station of control point of Ith panel
THET(I)	inclination angle at Ith panel control point
DELTA(I)	incidence angle of Ith panel
AREA(I)	surface area of Ith panel
XC(L,M)	panel corner points at Lth axial station of Mth segment

YC(L,N,M)	y corner point at Lth axial station of Nth meridional angle of Mth segment
ZC(L,N,M)	z corner point at Lth axial station of Nth meridional angle of Mth segment
AN(I,J)	temporary array for aerodynamic influence coefficients
UB(1,I,J)	temporary u-component influence coefficient array
UB(2,1,J)	temporary v-component influence coefficient array
UB(3,I,J)	temporary w-component influence coefficient array

The dimensions and indices defining the starting locations of each of these equivalent arrays are found in common DIMENS. The starting indices may typically be found by preceding the first two or three letters of the array name with I.

Additional arrays associated with the solution for the panel source strengths in SOLVE as identified by item 3 in Figure A-2. Only the arrays containing the panel strengths are saved. The strengths for up to seven flow conditions may be retained to allow for using the same shape data for more than one store. The equivalently dimensioned arrays in blank common looks like:

COMMON XPT(NBODY), YPT(NBODY), ZPT(NBODY), THET(NBODY), DELTA(NBODY), AREA(NBODY), XC(KX), YC(KXKR), ZC(KXKR), GB(NBODY, IALP), VB(NBODY), AN(MAXKR, MAXKR),..., A(NADIM)

where the arrays XPT through ZC contain the same information as before and

- GB(I,J) strength of Ith panel for fuselage (J=1) or Jth store of given shape
- VB(I) temporary array; contains initial velocity boundary condition which is destroyed during the solution

# AN(I,J) temporary array; used to hold the aerodynamic influence coefficients

At the conclusion of the calculation of the fuselage body source strengths identified by a call to IOWRIT in Figure A-2, arrays XPT through GB are saved on TAPE7. At the conclusion of the remaining body calculations all arrays required for Program II are saved on TAPE10. This occurs during the call to routine FRSTRT identified as item 4 in Figure A-2. For the fuselage, all variables and arrays in common blocks BGEOM, BOPTNS, BINLET, BINSHK, BSHOCK, DIMENS, HEAD, PARAM, and the blank common arrays previously saved on TAPE7 are written onto TAPE10. These commons contain all the information necessary to restart the calculations in Program II.

In Program I when both a noncircular fuselage and an elliptic store are to be analyzed, the results of the fuselage calculation are saved on an external file as indicated above. The data for the store or stores overwrite previous values. The sequence employed in computing elliptic store panel strengths is performed in a slightly different manner from the fuselage. In order to take maximum advantage of similarities in store shapes, the geometric properties of the panels and aerodynamic influence coefficients of a given shape are computed only once. The placement of a store in a different position or orientation causes only a variation in the boundary conditions. Only the strengths of the source panels associated with the additional stores of identical shape have to be saved. Provision for two elliptic store shapes is included in the program.

The computation sequence for the stores has been modified to read the geometric store input by shape first. The aerodynamic influence calculations are then made for each individual store. The impact of this sequence of computations for the store in blank common is to break the sequence 1 through 4 as used for the fuselage after item 2 in order to temporarily save all arrays

on TAPEll. This break in the sequence is indicated by item 5 in Figure A-2. At this point arrays XPT through ZC and common blocks BGEOM, BOPTNS, BSHOCK, DIMENS, HEAD, and PARAM are saved for each of the elliptic store shapes as previously described for the fuselage. The loop on the number of shapes is then repeated in which the above variables are read and the source strengths computed for each of the stores of that shape. The above labeled common blocks and arrays XPT through GB are saved on TAPE10 by routine FRSTRT. Blank common is then used to copy the aerodynamic influence coefficients from TAPE9 and TAPE8 to TAPE10. Blank common is equivalently dimensioned as

COMMON AN (KRAD, KRAD),..., A (NADIM)

for the TAPE9 transfer and then

COMMON UB (3, KRAD, KRAD),..., A (NADIM)

for the TAPE8 transfer of data.

TAPE10 is rewound and the records containing the fuselage arrays are read for use by DPHRS at item 6 in Figure A-2. FRSTRT reinitializes blank common and the various labeled commons identical to that configuration at the point identified by item 3 to allow use of the noncircular fuselage solution for the wing boundary conditions.

The second use of blank common in Program I is to contain the aerodynamic influence coefficients associated with the u-velocity panel solution for the wing-fuselage-pylon of the parent aircraft. At item 7 in Figure A-2 DPCOEF uses blank common to hold the coefficients and the right hand side through the panel strength solution. For these computations blank common has the dimensions of

COMMON FVN (200,N+1)

where

FVN(I,J) u-velocity panel influence coefficients

FVN(I,N+1) on input is the boundary condition of the Ith panel; on output is the strength of the Ith panel

N number of u-velocity panels

The third use of blank common in Program I is to contain the arrays used in the condensation of u-velocity panel strengths to strengths associated with single corners. Blank common is used to contain the arrays of corner points, net strengths, and orientation information. These calculations are performed in routine NULYT identified as item 8 in Figure A-2. The information is retained in blank common only until it can be written onto TAPE12 by WRFILE. During this time blank common has the dimensions of

COMMON XPT(500), YPT(100), ZPT(100), SPHI(40), CPHI(40), SWP(500), SNBP(40), CSBP(40), THTBP(40), DPNET(500), XPTS(1000), YPTS(100), ZPTS(100), SPHS(40), CPHS(40), SWPS(1000), THTNET(1000)

#### where

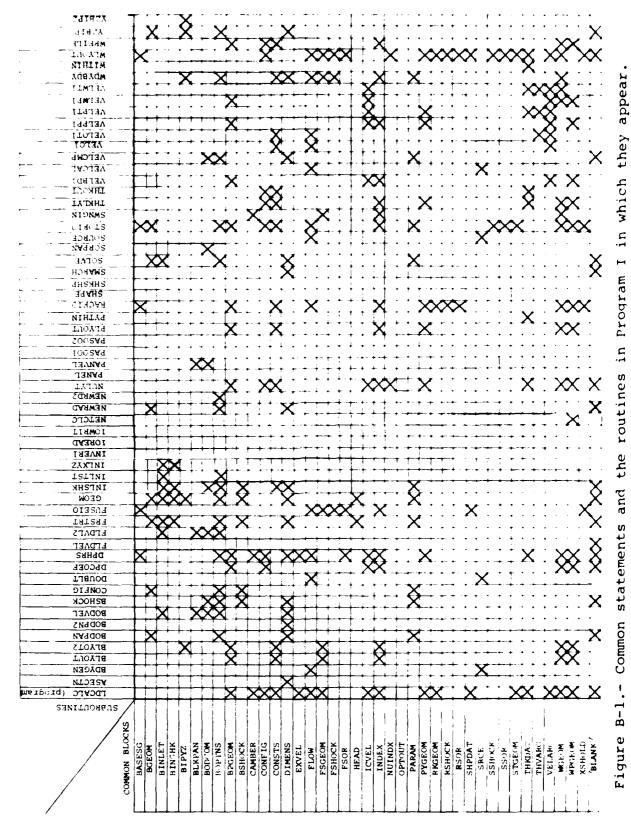
XPT(I)	$\mathbf{x_w}$ coordinate of Ith wing/body/pylon constant u-velocity corner point
YPT (J)	<pre>yw coordinate of Jth chordwise row associated with wing/body/pylon constant u-velocity corner points</pre>
ZPT (J)	<pre>z<sub>w</sub> coordinate of Jth chordwise row associated with wing/body/pylon constant u-velocity corner points</pre>
SPHI (J)	sine of dihedral angle associated with Jth row of wing constant u-velocity corner points
CPHI(J)	cosine of dihedral angle associated with Jth row of wing constant u-velocity corner points
SWP(J)	leading-edge slope of semi-infinite influencing

triangle associated with Jth constant u-velocity

corner point

SNBP(J)	sine of orientation angle of Jth row of body interference shell u-velocity corner points
CSBP(J)	cosine of orientation angle of Jth row of body interference shell u-velocity corner points
THTBP (J)	polar angle in cross-sectional plane defining the Ith row of fuselage constant u-velocity corner points; positive in counterclockwise rotation from positive y <sub>B</sub> axis
DPNET(I)	net strength of Ith constant u-velocity corner point
XPTS(I)	$\mathbf{x}_{\mathbf{W}}$ coordinate of Ith wing/pylon thickness source panel corner point
YPTS (J)	$y_{\mathbf{W}}$ coordinate of Jth chordwise row of wing/pylon thickness source panel corner points
ZPTS (J)	$\mathbf{z}_{\mathbf{w}}$ coordinate of Jth chordwise row of wing/pylon thickness source panel corner points
SPHS (J)	sine of dihedral angle associated with Jth row of wing source panel corner points
CPHS (J)	cosine of dihedral angle associated with Jth row of wing source panel corner points
SWPS(I)	leading-edge slope of semi-infinite influencing triangle associated with Ith source panel corner point
THTNET(I)	net strength of Ith thickness source panel corner point

Blank common is last used in Program I by FRSTRT as previously mentioned as temporary array space to copy the source panel data for the fuselage and store bodies from TAPE10 to TAPE12. See descriptions of FRSTRT for sequence of operations involved in file transfer. This reference to blank common is identified as item 9 in Figure A-2.



#### REFERENCES

- Dillenius, M. F. E., Goodwin, F. K., and Nielsen, J. N.: Prediction of Supersonic Store Separation Characteristics.
   Vol. I - Theoretical Methods and Comparisons with Experiment. Technical Report AFFDL-TR-76-41, Vol. I, May 1976.
- 2. Krasnov, N. F.: Aerodynamics of Bodies of Revolution. Edited by Deane N. Morris, Elsevier, New York, 1970.
- 3. Goodwin, F. K., Dillenius, M. F. E., and Mullen, J., Jr.: Prediction of Supersonic Store Separation Characteristics Including Fuselage and Stores of Noncircular Cross Section. Vol. I - Theoretical Methods and Comparisons with Experiment. Technical Report AFWAL-TR-80-3032, Vol. I, Nov. 1980.
- 4. Woodward, F. A.: An Improved Method for the Aerodynamic Analysis of Wing-Body-Tail Configurations in Subsonic and Supersonic Flow, Part I - Theory and Applications. NASA CR-2228 Part I, May 1973.